THE

ELECTRICAL REVIEW.

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CONTENTS:

	PAGE
The *Engineer* Competition	719
The Achievements of Physical Chemistry (*concluded*)	721
On the Cathode Rays and their Probable Relation to the Röntgen Rays	722
The Inception and Extension of Submarine Telegraphy ...	722
Governing of Water Power under Variable Loads	723
A Geometrical Solution of the Problem of Finding the Radii of Different Pulleys (*illustrated*)	724
What Electric Lighting really Costs (*continued*)	725
Correspondence:—The Jandus Lamp	726
Re McDonald Primary Cell	726
Machine Telegraphy (*illustrated*)	726
The Late Sir Benjamin Ward Richardson and Living Burial	727
Leyton Electric Lighting Works	728
"Fusion of Electric Wires," and the Cause	728
Induction in Multiple Core Cables	723
A Disclaimer	729
International Submarine Telegraph Memorial	729
Motor Vehicles	729
Business Notices, &c.	729
Electric Lighting Notes	730
Electric Traction and Motive Power Notes	732
The Electric Lighting of Manchester (*illustrated*)	733
Free Lamps	738
Telegraph and Telephone Notes	739
Contracts Open and Closed	740
Notes	740
City Notes	744
Traffic Receipts	744
Share List of Electrical Companies	745
Reviews:—Auto-Cars	746
Carriages without Horses shall Go!	747
Applied Electro-Chemistry.—IV. (*concluded*)	748
Proceedings of Societies:—	
The Institution of Electrical Engineers	749
New Patents	750
Abstracts of Published Specifications	750

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THE "ENGINEER" COMPETITION.

Now that the motor car has obtained legal possession of the road, there is some hope of the contest instituted by our contemporary, the *Engineer*, being a success. The competition takes place in May next, and engineers with workshops to fill might well expend some time and energy in getting ready a car for the trial. We observe that The British Motor Syndicate, Limited, whose prospectus was issued to the public on Saturday, November 28th, have made a most unwarrantable use of our contemporary's name upon this prospectus, the name of one of the so-called patentees being deliberately set down in the prospectus as "*The Engineer*," as though the said patentee were proprietor of the Journal. The fact is that his connection with the *Engineer* has terminated, and the use of "*The Engineer's*" name as apparently in league with the syndicate is wholly unjustifiable. The British Motor Syndicate claims to be master of the situation simply on the strength of what it terms its master patents. And what are these and who are the patentees? There is Mr. Holt, formerly of Crossley's Gas Engine Works, with his vast experience of the Otto gas engine. The Otto engine, as a patent, has expired, and everyone uses the Otto cycle to-day as he pleases. There is Gottlieb Daimler, of the Daimler vertical motor, which is good enough in its way, but a great vibrator. There is Mr. Worby Beaumont, late joint-editor of the *Engineer*; there is M. Bollée, a clever and ingenious Frenchman; Pennington, whose motor is remarkable for lightness; a Count de Dion, who has a steam engine; W. C. Bersey, whose "invention," the electric cab is, and J. J. H. Sturmey, "editor of the *Autocar* and many others." In it the meaning of many others is not clear. It may mean many other patentees, or many other editorial posts. Sir David Salomons very correctly doubted the value of any patent on motor cars, and if the British public subscribe the £3,000,000 asked for, they will be doing so, not because there is any value in the patents, but simply because the motor car industry is a new industry, and the chances are in favour of the first venturers. We should like to know, what is there to prevent any manufacturing engineer from making an oil, benzolene, steam, gas, or electric motor car that will not be every whit as good as any that can be made under any patent claimed by this Syndicate? Probably, when the *Engineer* competition takes place in May, and the impudent prospectus before us has been forgotten, the best motors will be found to be entirely apart from any of the so-called master patents claimed by the Syndicate.

Like many other prospectuses, we note the present one announces the lists open from Monday till Wednesday. Thus the prospectus is issued to the excited public, and the list opened and closed in the period of time that makes it impossible for any technical journal to print a line of criticism that will be seen by the public who subscribe. It would be well that no list should close until at least 14 days after issue of prospectus, but the Limited Liability Act has rendered possible many things which disfigure the financial world.

Since writing the above, the prospectus of the Motor Syndicate has received some attention at the hands of the daily papers. The *Financial Times* points out that out of the £3,000,000 asked for, only a paltry £300,000 is left for working capital, and asks very pointedly how patents purchased for £240,000, are now worth £2,700,000? It also asks, Are the offers of many thousands for licenses, offers from various other of Mr. Lawson's companies?

Mr. Radcliffe Ward, who has done something in electrical vehicles, very properly resents the syndicate's claim that they own all the valuable motors, electric and otherwise. If any accumulator-worked car is valuable, then Mr. Ward's electrical omnibus is fully as valuable and as matured as any other, and it is not owned by Mr. Lawson or his syndicates. Other inventors equally object to the sweeping claims of the Syndicate as put forward in their impudent prospectus. The Brighton race of Saturday, November 14th, has been utilised by Mr. Lawson and his associates simply as a lever to extract money from the people. To ask three millions for a few expired, half-expired, or otherwise valueless patents, is sheer audacity. As we have said above, the quality of the prospectus is shown by the manner in which the *Engineer* is dragged without leave into it as a supporter of the scheme.

Since the prospectus appeared which led to the foregoing remarks, the daily papers have been flooded with disclaimers. Among many others, we note Mr. Holt and Mr. W. Beaumont both deny that they have allowed their names to be so used. The Syndicate have played this little trick upon the two gentlemen named and upon the public entirely off their own bat. Are we to infer that all the other names which appear blazoned on the prospectus are placed there with no better right? We should think Messrs. Holt and Beaumont have serious cause for complaint against the Syndicate for putting them in so bad a light before the public, as they are made to appear as supporters of the Syndicate's intentions, such intentions being to sell for nearly three millions what is not worth anything like a tenth of the amount. It is specially to be noted that while Mr. Holt is put forward as a patentee connected with gas engines, he states himself that he has simply sold certain patents relating to vehicles propelled by steam for a *small consideration*. The italics are ours. To what proportion of the £2,700,000 has this small consideration grown? We consider it an extremely unfair thing to thus make use of the names of professional men. The injury done them by such an act will extend to quarters where their disclaimers are not likely to reach, for the advantage of obtaining the first hearing is especially great in the case of a prospectus.

The Treatment of Leather Belting.

It is well known to every practical man that leather belting requires a certain amount of attention. The treatment of the belt must be, of course, to a certain extent adapted to the conditions under which the belting is working; it differs according as the belt runs in damp or dry places, in oil, or in an atmosphere impregnated with corrosive vapours. If the belting works in a dry place it is necessary that a little fat should be applied to it from time to time to prevent premature development of cracks. Heavily loaded belts must after a certain time be tightened up, and this has the effect of considerably reducing their tensile strength. To prevent the slipping which occurs just before the belt is tightened different devices are resorted to; for example, sprinkling on resin or gypsum, or smearing on friction fat, &c. All these plans, however, are effective only for a short time, and it is just these that accelerate most the destruction of the leather, since nothing is more injurious to belting than resinous substances, or substances with a corrosive action. They cause the leather, into whose pores they penetrate the more it is stretched, to rot and fall to pieces. In the case of leather driving belts which are continually in contact with oil (as in screw-making machinery), the life of the belt is chiefly influenced by the nature of the oil. The fatty substances are acted upon by the air and acids are produced, which, of course, are extremely injurious to leather. When such belts stop working, the layer of fat and dust which has been formed on the surface has to be removed by treatment with paraffin oil and sawdust. The original efficiency of the belt is, however, never again restored and slipping takes place again shortly after. A new process of restoring worn out belting has recently been brought out by Max Krieger & Co., Berlin, which consists essentially in imbedding the belting, after it has been thoroughly cleaned, in a special composition and subjecting it therein to a moderate heat. This composition, which contains a number of different silicates, serves two purposes, namely, to add fat to belts which have lost their pliability, and abstract it from those which already have too much. The fat seems to flow from the belt to the composition, or *vice versâ*, till a kind of equilibrium is established. The effect of the silicate composition can be increased by raising the temperature, so that by this means old resined belts can be restored to their original pliability, and made available for use for a considerable time longer. A second advantage of this moistening of the leather consists in this, that stretched belts under this treatment return to their original length. If a belt, therefore, is first saturated with fat and then deprived of it by this process, it becomes more dense and lasts longer. It acquires an extraordinary power of resisting subsequent stretching. Belts that have been treated in this way work very uniformly for a long time, and require very little lubricating. The use of resin, &c., for increasing friction becomes altogether unnecessary. The power of absorbing lubricants is very much reduced, so that the belts will run a long time before they require to be treated again. The inventors assert that the life of a belt is doubled by this process, an assertion which, if verified, ought to lead to its being extensively adopted. (*See Elektro. Zeitschrift*, xvii., page 636.)

THE ACHIEVEMENTS OF PHYSICAL CHEMISTRY.

(*Concluded from page* 694.)

After referring more particularly to Meyer's work, and also to the researches of Auwers on cryoscopy, and referring to the investigations of Van der Waals, Ostwald, Bredig and A. A. Noyes, the lecturer approached the all-important subject of the researches of Arrhenius.

In 1884, Arrhenius published the results of researches on the electrical conductivity of solutions, on which he had been engaged for two years. In the course of his studies he was led to the conclusion that only a part of the molecules of an electrolyte are concerned in conveying the electrical current, and that it is necessary to distinguish between "active" and "inactive" molecules in this regard. The conductivity is greater, in proportion to the account of the electrolyte present, for dilute than for concentrated solutions, and for an infinite dilution the molecules would, presumably, become all "active." Arrhenius pointed out, also, that there is a close connection between the number of "active" molecules as determined by the electrical conductivity of solutions and the "avidity" of acids as determined by the thermo-chemical researches of Thomsen. His first explanation of the cause of the difference between the "active" and "inactive" molecules, was, however, unsatisfactory, and was not well received.

Shortly after, in his first development of his theory of solutions, van't Hoff was compelled to admit that many substances in aqueous solution cause a depression of the freezing point much greater than they should in proportion to their molecular weights. He expressed the deviation by the use of a factor, "i," which is, for electrolytes, always greater than unity, and expresses the number of times the depression exceeds the theoretical depression as calculated from the molecular weight. This factor was at first considered to be a constant; but it is now known that it is variable, and that it increases with the dilution. The obvious meaning of this factor is that the molecules of electrolytes are separated into two or more parts when dissolved in water, or rather liquids which have a similar effect in causing electrical conductivity. But just as chemists were very slow to see that the abnormal densities of ammonium chloride, and of many other substances, are due to dissociation, so van't Hoff did not draw a conclusion which seemed to be so contradictory to all preconceived notions about the bodies in question. Arrhenius, however, saw the logical conclusion, and his studies had prepared him for its acceptance. As a result, he proposed in 1887 his theory of electrolytic dissociation.

This theory, which seemed at first very improbable, has shown itself capable of co-ordinating the facts of many diverse fields of work, and has proved more valuable in the incentive which it has given to research, and more prolific of results than any other theory proposed during the last decade. According to the theory, an electrolyte when dissolved in water, and sometimes when dissolved in other solvents, is separated more or less completely into its ions.

The empirical basis for the theory lies in the correspondence between electrolytic conductivity and the divergence from the normal depression of the freezing point, and lowering of the vapour pressure; in the correspondence of both with the "avidity" of acids which has already been referred to; in the quantitative connection between each of these and the chemical effect of acids, as shown in the inversion of cane sugar and saponification of methyl acetate; in the satisfactory explanation which it gives for the independent migration of ions during electrolyses as established by the work of Hittorf, Kohlrauch and others; in the fact that an electrolyte obeys the same law for dissociation with increasing dilution as a gas under diminishing pressure, first pointed out theoretically by Ostwald and Planck, and then experimentally established by Ostwald, Wildermann, Loomis and others; and in general by the fact that the properties of a dilute solution of an electrolyte are dependent on the sum of the properties of the ions present rather than of the chemical compound which those ions may combine to produce. It would take me too far to illustrate this last statement as shown to be true of the density, colour, and other properties of solution.

The theory has thrown light upon many chemical riddles, and has placed the chemist in a position to predict phenomena, which could formerly be known only as the result of experiment. It suggests at once the distinction between reactions of ions and reactions of bodies which do not undergo ionic dissociation. The former take place in solutions at ordinary temperatures, and so instantaneously that the time factor cannot be measured; the latter frequently require an elevated temperature, and are sometimes very slow. The distinction is, perhaps, a practical rather than a strictly logical one, for theoretical considerations lead us inevitably to the conclusion that only additive reactions, and in many cases not even those, can take place without a previous dissociation of some sort. In this view the distinction between ionic reactions and others is that in solutions of electrolytes a considerable portion of the compounds have undergone dissociation; and as any ion is removed by precipitation, or otherwise, the remainder of the compound of which it is a part undergoes rapid dissociation, owing to the resulting dilution of the solution. In such cases the dissociation appears to take place almost exclusively at one point in the compound, and the reactions are clean and practically quantitative. In what may be called non-ionic reactions, on the other hand, the initial dissociation appears to be trifling, and notably with organic compounds, may take place at several points; the reactions between the resulting parts must be slow and may give rise to a variety of compounds.

In accordance with the theory, only those elements of groups which exists as independent ions in a solution enter readily into combination with other ions. Hence an atom which forms a part of a complex ion as the iron of ferro- or ferri-cyanides, and the chlorine of chloro-platinic acid and of potassium chlorate cannot be detected by the ordinary reagents for these elements. This principle is of fundamental importance for analytical chemistry, and has, of course, in its empirical form, been long recognised. In the case of analytical chemistry, especially the new theories of physical chemistry seem destined to transform what has been, hitherto, an almost exclusively empirical science and raise it to a higher plane.

Illustrations of the practical applications of the theory in this field of work were then given at length.

It is not alone in chemistry that the theories of osmotic pressure and of electrolytic dissociation have proved of practical value. Nernst has developed from these theories a theory for the cause of the electromotive force in batteries, which, while it may not, as yet, have received general acceptance, is a more useful expression for our present knowledge than any previously proposed. The most important conception at the basis of this theory is that of what may be called a solution pressure for metals, corresponding, in some sense, to the vapour pressure of liquids. When zinc, for instance, is in contact with water, or an aqueous solution, this solution pressure is a force impelling the atoms of zinc to pass into solution. In order that they may do so, however, each atom must pass over into the state of an ion; that is, it must receive a charge of positive electricity which is carried with it into the solution. But only a very few atoms can pass into solution before the negative charge left in the mass of the zinc in proportion as the positive ions separate from it will cause such an accumulation of zinc ions in proximity with the zinc as to balance the solution pressure. If, however, an opportunity is given for the escape of the negative charge from the zinc, and at the same time positive ions are allowed to escape from the solution at some other point, the zinc will continue to dissolve and currents of electricity will be set up. Thus, in the Daniell or gravity cell, zinc ions pass into solution and a corresponding number of copper ions are deposited. The force which causes the movement of the ions, and with them the transference of electrical energy within the cell, is mainly the very high solution pressure of the zinc as compared with that of copper. Other factors, such as the osmotic pressure of zinc ions already in solutions, which tends to counteract the solution pressure of the zinc, the osmotic pressure of copper ions which aids in the separation of the copper, and the different velocity of translation for various ions which may cause differences of potential when the fluids of the cell are not homogeneous, are most of them comparatively small in their effect.

No means has been found for the direct determination of

the solution pressure of metals, but it may be calculated from the difference in potential between a metal and a solution of one of its salts. Methods for the determination of the latter have been devised by Ostwald, and improved by Paschen. By the use of these and other constants, which the researches of physical chemistry have placed in his hands, the physicist can now calculate the electromotive force which can be obtained by various combinations of metals and solutions. On this side the theory has rendered essentially the same service for the galvanic cell which the atomic theory rendered for chemical compounds when it furnished the means for calculating their percentage composition. As in the early days of the atomic theory, many of the constants in question are imperfectly known, but since the theory has shown clearly their independence, new means for their determination and for the control of their accuracy are constantly being discovered.

Everyone who is familiar with the extremely wasteful character of all processes now at our disposal for the transformation of chemical into mechanical energy, must have had the thought that there is surely some means of saving a part of the enormous loss. At present, the attention of the scientific world is turned toward the transformation of the chemical energy of coal into electrical energy as the probable solution of this problem. It seems to be almost certain that physical chemistry has already made clear the principles by means of which such a transformation may be accomplished. Indeed, Dr. W. Borchers, by the use of a solution of cuprous chloride with producer gas, or carbon monoxide on one side and air on the other, has already obtained an electrical current which corresponds to a transformation of 30 per cent. of the chemical energy into electrical. This is an efficiency three times that of the best steam engines. There is no probability that this method can ever be practically useful, but that a practical method will soon be discovered is, at least, possible.

ON THE CATHODE RAYS AND THEIR PROBABLE RELATION TO THE RÖNTGEN RAYS.*

By P. LENARD.

The cathode rays, as produced by the electric discharge in gases, have long been known. To these a new kind of rays with kindred properties has been added by the recent discovery of Röntgen. The properties of these newly discovered rays, appear in the light of the present state of knowledge, to be in agreement with the hypothesis that they are essentially a limiting case of the cathode rays; namely, cathode rays with infinitely small magnetic deflectibility. Röntgen rays, according to our hypothesis, would consist of the same ether processes as the cathode rays, but with a special value or series of special values of one of their parameters. What points to this kind of theory, will now be indicated. By cathode rays, are to be understood such rays as proceed from the cathode in a discharge tube.

In the first place, it is to be noted, that we already are acquainted with an unbroken series of different kinds of cathode rays which differ only in the amount of their deflectibility by a magnet, just as different kinds of light are distinguished by their refrangibility in a certain medium. The deflectibility of a cathode ray remains the same throughout its whole course, be the gaseous or solid media through which it passes what they may, just as the colour of a light ray remains the same in analogous conditions. The case of fluorescence is an exception in the case of light; and Röntgen's discovery has supplied an analogy to this in the case of the cathode rays; namely, the conversion of cathode rays of finite deflectibility into rays of imperceptibly small deflectibility by the action of ponderable matter.

Cathode rays of very great deflectibility and all intermediate shades down to comparatively small deflectibility, can be produced in discharge tubes. The lower the gas pressure is, in such tubes, and, therefore, the greater the electric forces which act upon the gas*, by so much the smaller is the deflectibility of the rays produced. The smallest attainable deflectibility is reached by the application of the greatest electrical forces.

The known kinds of cathode rays have, so far as I have been able to prove it, the property of being absorbed by ponderable matter approximately in proportion to its density. That is to say, in so far as the amount of the absorption is determined by the medium, it is about twice as much for a medium of twice the density. This property, being independent of the amount of the deflectibility, appears to be a characteristic property of the cathode rays; it is, as is well known, also a property of the Röntgen rays.

The different kinds of cathode rays have properties which vary gradually with the amount of their deflectibility in the following way, so far as quantitative experiments have been made: The less deflectible a cathode ray is, the less will it be (1) absorbed by passing through a ponderable medium; the less will it be (2) dispersed by it, that is to say, the less turbid is the material to it. This relation has been found to hold for cathode rays which issue from discharge tubes with thin windows, and which, as experiment shows, contain only minute traces of Röntgen rays, the window being very thin. It is evident that with cathode rays of infinitely small magnetic deflectibility, both the absorption and the dispersion is indicated to be small by our hypothesis. Just these are the properties of the Röntgen rays.

Further properties of the cathode rays in relation to their deflectibility have not yet been investigated. It is probable that the accurateness of our law of absorption, for each medium is also a function of the deflectibility of the rays. Common to all kinds of cathode rays and to the Röntgen rays is the property of making gases conducting, and also the allied property of facilitating the formation of fog. Common also to all these rays is the property of exciting phosphorescence and chemical action.

From what has been stated above, the existence of a gradual transition from the cathode rays to the Röntgen rays appears to be probable. On the other hand, Lodge, and J. J. Thomson, have pointed out the possibility of a gradual transition from the Röntgen rays to the optical spectrum through the region of the rays recently discovered by M. Henri Becquerel.

* Vortrag vor der deutschen Naturforscher Versammlungin Frankfurt-a-M. *September*, 1896.

* Coudres has recently shown the electrical forces and not the gas pressure is what really determines the deflectibility; he has, for instance, succeeded in producing cathode rays of small deflectibility with relatively high gas pressures, by the application of strong electric forces.

"THE INCEPTION AND EXTENSION OF SUBMARINE TELEGRAPHY."

It is, perhaps, a subject for congratulation that the Committee of the proposed International Telegraph Memorial have now adopted the resolution of Mr. Charles Bright, F.R.S.E., seconded by Mr. J. Wolfe Barry, C.B., F.R.S., as President of the Institution of Civil Engineers. The purport of this resolution was to waive any international memorial to the "Inception and Extension of Submarine Telegraphy" until occasion presented itself in 1901, on November 15th, of which year the jubilee of effective submarine telegraphy would come round. An additional resolution backing up the above was proposed by Sir Robert Herbert, G.C.B. (a Director of the Telegraph Construction and Maintenance Company), and seconded by J. C. Lamb, C.B., assistant secretary to H.M. Post Office. We are no great believers in the sanctity of the elapse of any particular period as being peculiarly adapted to jubilations; but this is an age for 50-year jubilees, and custom must necessarily rule such matters to a great extent. However, quite apart from this, any resolution which defers the matter is welcome; for it is quite clear that the promoters of the memorial were either insufficiently versed in the subject they proposed to memorialise, or else were inspired with a keen sense of partiality. To associate the names of the late Sir John Pender, Sir James Anderson, and Mr. Cyrus Field with the "Inception and Extension of Submarine Telegraphy," with entire disregard to the various scientists and engineers who rendered submarine telegraphy possible and a subject of commercial profit, would have been absurd on the face of it. The three names selected were those of keen business men,

pure and simple; and it would have been a matter for regret if the historian had been led into the belief that these were the original workers in this highly scientific branch of engineering. Even if a memorial were to be set up to the financiers alone (properly labelled as such), it would be quite out of keeping with justice to suppress the name of John Watkins Brett, who obtained the first concession for a cable between England and France; similarly, we have the late Sir James Carmichael, Bart., one of the founders of the first English submarine telegraph company, which did such useful work at that early period. Again, there is the late Sir Curtis Lampson, who was very suitably created a baronet for his services in keeping the Atlantic Telegraph Company alive after the cable expeditions of 1858.

Besides these, there are the late Mr. Thomas Brassey, Sir Daniel Gooch, Bart., Sir Richard Glass, and Sir George Elliot, Bart., all of whom rendered very remarkable services (to the community as well as to themselves) as capitalists and as financial workers. The most conspicuous mistake, however, was failing to recognise those on the technical side who proved the thing to be practicable. In the course of a few words at the meeting, Lord Kelvin referred to the fact that the first man to lay a cable in deep water was the late Sir Charles Bright, and there can be no question that to leave out this name in association with such a title would have stamped the whole concern with a strong vein of partiality. We also have to deal with men like Crampton and Gisborne amongst the engineers; besides which there are several electricians, such as the late Werner Siemens, Wildman Whitehouse, Willoughby Smith, and Cromwell Varley, to overlook whom would be almost equally open to comment. Here we have only referred to those who have passed away; but if, apart from any memorial, it were desired to record the names of all prominent workers, we should have to add many more. Happily, however, Mr. Charles Bright conceived a settlement of the whole affair by the resolution referred to, in which he suggested that the ends would be best met by confining attention, for the present, to a personal memorial to the late Sir John Pender, G.C.M.G., to commemorate his great services, as a capitalist and in a business way, to the development and extension of submarine telegraphy.

When the time comes for erecting a general international memorial to submarine telegraphy, if any names are to be associated with it at all, they must certainly be selected on entirely impartial grounds, and all placed on an even footing, either in order of date or of alphabet.

One of the newspaper correspondents on this subject spoke of the technical element as "paid employés carrying out the instructions of their superiors." Most of us are paid employés in some sense or another of our fellow creatures. But this does not seem to be any reason for selecting the names of three financiers, all of about the same period, to represent the inception and extension of submarine telegraphy; and none of those to whom he apparently referred were in any different position to that of the engineer of such great accomplishments as the Forth Bridge, for instance. Were these pioneer engineers and electricians told by the business men *how* to construct, lay, test, or work their cables, and did the latter design the apparatus for carrying out these objects? If this had been so there would have been some justification for speaking of the engineers and electricians as "carrying out the instructions of their superiors." This would, indeed, have been a case of the financiers teaching the engineers and electricians their business; and this we know was not so.

Just now, whilst the inception of electric lighting is comparatively fresh in our minds, we should be astounded at the business people laying claim to having been the "inceptors." In reality, it is equally ridiculous for the financial promoters to do so as regards submarine telegraphy. To the capitalist and financier of cables naturally—and in the first instance quite rightly—accrues the bulk of any pecuniary gain from such undertakings; but in the matter of *kudos*, we should always expect to see an equal measure bestowed on the engineers and electricians who paved the way for these extensions by their early work; indeed, as a rule, the capitalist does not begrudge the scientist *all* the honour, seeing that he (the capitalist) has already reaped abundant reward for his foresight in a pecuniary, and more tangible, way. If so, in other branches of engineering industry, why not also in submarine telegraphy?

GOVERNING OF WATER POWER UNDER VARIABLE LOADS.

The governing of water motors under variable load is rendered difficult chiefly by the inertia of the water which supplies the power, and this is the view taken by Mr. M. S. Parker, in his paper read before the American Society of Civil Engineers, on December 2nd.

For electric tramways, indeed, the sudden and wide variation of load has made the governing of water-power so uncertain, that it was believed a few years ago that small plants at least could not be successfully operated by water-power. For powers of a fairly constant type the ordinary ball governor is satisfactory, but it is quite inadequate when the load changes rapidly.

A case which came under the author's notice set him experimenting, and the present paper is the outcome of what he found. The data were a pair of 22½-inch Victor turbines working under a head of 40 feet, and generating 400 H.P. for a 6-mile tramway with a 20-minute service. From four to ten cars are run each with a pair of 15-H.P. motors. At times when four or more cars are in service they are all stopped at once, which, of course, reduces the load from 120 H.P. to nil. This caused frequent burning out of armatures, even though an attempt was made to check the sudden accession of speed by means of a large fly-wheel, with five 2-inch ropes to drive it. The converse trouble arose when several cars had to start together. The water is led to the wheels by a 9-foot diameter penstock, 400 feet long. Obviously such a mass of water cannot start and stop its flow to suit the wheel demand, and the author hints very properly that a first desideratum of a water power should be a vent or stand-pipe as large as the penstock or supply pipe. The vent pipes ordinarily used are too small to be of any service. The suggestion of a large stand-pipe is very good, where the head of supply is moderate; but where there is a large head, a corresponding stand-pipe is, if not impossible, at least impracticable. In such a case we cannot see why a stand-pipe with a closed top, or air vessel, should not be employed. Where the water supply exceeds the demand, it would also be a simple thing to arrange a waste sluice that would open as the wheel sluice was closed, in order that the movement of the stream should never be checked. Undoubtedly the unaided long flume does present a great obstacle to governing, and the increment of pressure with a governing sluice of quick action must be considerable, and ought to be considered either by the methods indicated or by a suitable safety valve. The power company considered several devices for disposing of the surplus current, but for various reasons abandoned them, and adopted the governor to be described. Though it failed at first to accomplish the results guaranteed by the inventor, it was sufficiently satisfactory to be paid for by the company, and has since been improved to the promised efficiency.

In the first place, there is an ordinary disc throttle valve on the turbine discharge, there is a high-speed engine regulator, and a gravity battery with its circuit. The regulator is powerful enough to control the wheel gates, and gets its power from the wheels. The engine regulator or governor is simply an indicator making or reversing the battery current, as the speed is above or below a given point, and the contacts can be adjusted as closely as required; indeed, so close, that the margin of contact forward or backward is almost nothing. The illustrations are not very clear, but it would appear that the throttle valve is worked by a rope with counter-weight from a rope pulley, which is turned in either direction by means of a pair of ratchet wheels actuated by reversed pawls on a swinging frame. According as the current is turned by the small governor, one or other pawl is dropped into action, and the rope-wheel turns. Obviously the throttle valve is moved with a rapidity measured by the speed of oscillation given to the pawl frame, and as the power to actuate this is practically unlimited, any desired speed can be given. The voltage and amperage record cards are reproduced for a day's run, and do not fall far short of similar records for engine driven plant. The author thinks that with conditions first made as favourable as possible in the original construction, the electric governor will then give satisfactory results. This can scarcely be called an electrical governor after all, for it is

entirely mechanical in every detail, except that of the governor contacts, and the use of a magnet to drop the pawls into action. The rapidity of action is hardly more than an entirely mechanical arrangement would secure, and the use of a pawl-driven ratchet suggests time.

A GEOMETRICAL SOLUTION OF THE PROBLEM OF FINDING THE RADII OF DIFFERENT PULLEYS; SO THAT THE SAME OPEN BELT SHALL FIT EACH AND EVERY PAIR.

By W. J. VARLEY.

Referring to figs. 1 and 1A, it will be seen that the perimeter of the outer figure (or circle) is equal to the sum of the perimeters of the two inner ones.

And referring to fig. 2, the two tangents on one side of the centre line are parallel to each other; and the distance between the tangents on both sides is the same. Then, the perimeter of the outer figure is equal to the perimeter of the

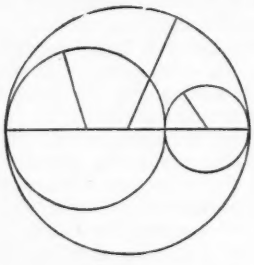


Fig. 1.

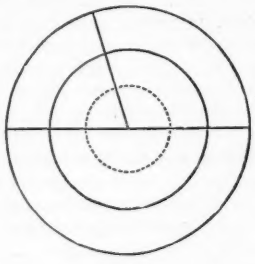


Fig. 1A.

inner one, plus the perimeter of a circle, whose radius is equal to the distance between each pair of parallel tangents; and the radius of the dotted arcs being equal to the same distance, the sum of the two dotted arcs, is the difference between the perimeters of the two figures.

Referring to fig. 3, the same reasoning applies, the radius of the dotted circle being the distance between the parallel tangents.

Referring to fig. 4, where the radius at one end is a point, the same reasoning applies.

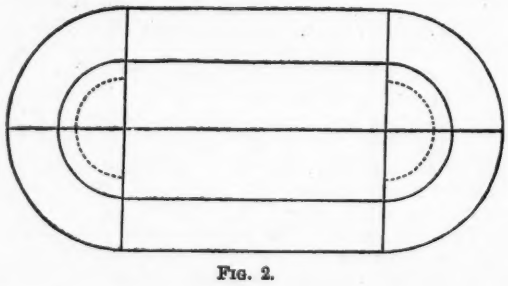


Fig. 2.

Referring to fig. 5, where the tangents are not parallel to the centre line, we wish to convert it to a figure having the same points for centres of the circles, having the same perimeter, and having the tangents parallel to the centre line. If the distance between centres be called radius, the angle made by the tangent and the centre line be called θ, 3,146 be called W, and C be called the semi-perimeter, we shall have

$$C = \sin\theta \times \frac{90 + \theta}{180} \times \pi + \cos\theta.$$

And, calling the unknown radius A, then $A\pi + 1$ must equal C, or

$$A = \sin\theta \times \frac{90 + \theta}{180} - \frac{\text{vers. } \sin\theta}{\pi},$$

that is (referring to the figure), the arc, A B, minus the vers. sin, B C, must be converted into a semicircle, whose radius we are required to find.

In the tables appended hereto, the value of A to radius unity is given for every $\frac{1}{10}$th of a degree, *i.e.*, for every 6′, and the tables are carried to the angle where the two equal pulleys would touch each other, they are not needed any further. The co-efficients in column B are equal to sin − A of the same angle.

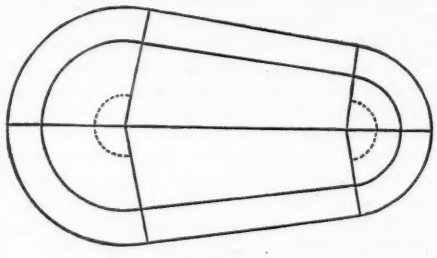


Fig. 3.

Referring to fig. 6. If we draw the tangent of the equal pulleys and of both maximum pulleys on the same side of the centre line, we shall get three lines intersecting as shown, and the radius of the circle which touches these three lines is always equal to the difference between $\frac{1}{2}$ tan, and A divided by (sec. − 1) of any limiting angle; these are the coefficients, C, in the tables. Their use is explained as follows:— We know that the belt in its extremes and centre positions must touch this circle, and if we assume that it also touches it in any other possible position, we shall err by a quantity so small that it may safely be neglected.

That is, if we draw a tangent touching this circle at any possible angle, it finds at once the radii of a pair of pulleys to fit the belt.

Note.—The centre of C is outside the belt, from 0° to 31° 10′ 30″, and the radius of C is 0 at that angle, and the centre is within the belt at any higher value.

Fig. 4.

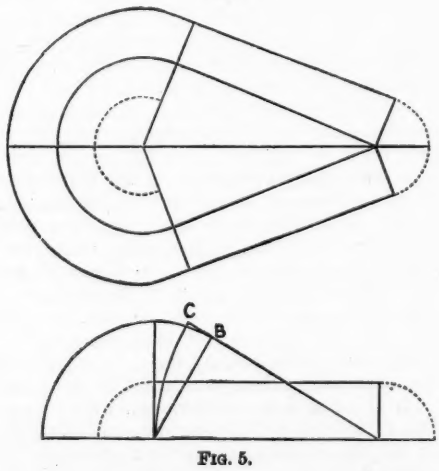


Fig. 5.

If we have given a belt for open belt pulleys, we can easily change it to cross-belt or *vice versâ;* as both open and cross-belt have the same limiting angle, which angle remains constant for the cross-belt; and the sum of the radii of any pair of cross-belt pulleys is always equal to the radius of the maximum pulley or size of the limiting angle.

If then, we have given a belt which fits a pair of pulleys set in position, and also another belt which fits another pair also set in position (whether in the same line of shafting or not is immaterial), we can easily find a second pair for each position, so that both belts can be used in either position, provided we do not exceed the limiting angle given by the pulleys of the smaller belt.

Let E equal the length of the larger, and E_1 equal the length of the smaller of two belts, then $(E - E_1) \times \cdot 159155 = d$, and d added to each radius of the smaller belt will give a pair to fit the larger belt, and if subtracted from the radii

of the two pulleys of the larger belt will give two pulleys to fit the smaller belt, provided d does not exceed the smaller radius on the larger belt.

Numerical Examples.

Let 40 equal the radius of the even pulleys and 100 the distance between centres.

Then $\frac{40}{100} = \cdot4 =$ the A of the limiting angle, which is 41° 2′ 22·5″, and the maximum radius is 100 × ·656578 = 65·6578, with data as above, find 6 pulleys to mate 6 given as under, viz., 10, 20, 30, 48, 54 and 60.

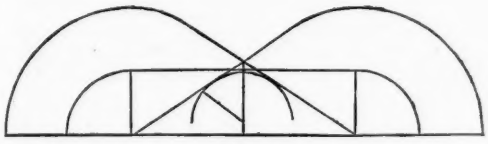


Fig. 6.

Taken in order as written, they are as follows :—

$\frac{40-10}{100} = \cdot3$, its mate is 40 + 21·378 = 61·378.

$\frac{40-20}{100} = \cdot2$, its mate is 40 + 15·852 = 55·852.

$\frac{40-30}{100} = \cdot1$, its mate is 40 + 8·809 = 48·809.

$\frac{48-40}{100} = \cdot08$, its mate is 40 − 8·88 = 31·12.

$\frac{54-40}{100} = \cdot14$, its mate is 40 − 17·083 = 22·917.

$\frac{60-40}{100} = \cdot2$, its mate is 40 − 27·151 = 12·849.

Taking the same data, powers may be found by dividing the limiting angle :

At 35°	...	63·283 and	5·925.
30°	...	60·932 „	10·932.
25°	...	58·245 „	15·983.
20°	...	55·221 „	21·019.
15°	...	51·869 „	25·987.
10°	...	48·204 „	30·839.
5°	...	44·238 „	35·522.
0°	...	40· „	40·.

Given a pair of cross belt pulleys, 20 and 10, to find a pair of open belt at an angle of 24°, 100 being the given distance. $\frac{20+10}{100} = \cdot3 =$ the sin of the limiting angle 17° 24′ ; we, therefore, cannot get a pair at the angle of 24°,

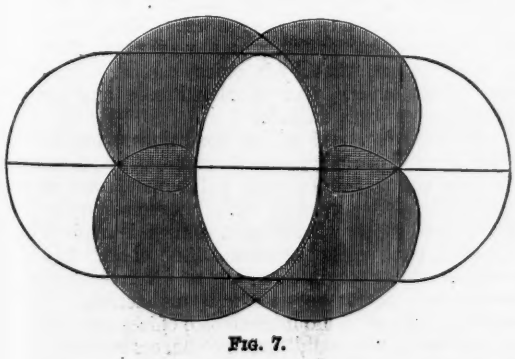


Fig. 7.

say, then, at 12°, the A of 12° is ·11085, and the A of 17°·24′ is ·16486, then 16·486 − 11·085 = 5·401 = lesser, and 16·486 + 9·706 = 25·486 = greater.

Now, given 40 as radius of even pulleys, and 100 as distance to find a pair whose velocities shall be as 6 : 1.

$(N-1) \times \frac{40}{100}$ must equal N A + B, or 6 A + B = 2.

We soon find that the angle lies between 30° 42′, and 30° 48′.

30° 42′ giving a plus error of ·00077
and 30° 48′ a minus error of ·00573

The sum = ·0065

Difference of arcs 6′ = 360″

and $\frac{77 \times 360}{650} = 14{\cdot}95''$

the angle is then 30°·42′ 14·95″

And by the ratio of diff. A = ·2978584
and B = ·2128492.

Then

40 − 29·78584 = 10·21415,

and 40 + 21·28492 = 61·28492,

$\frac{61{\cdot}28492}{10{\cdot}21415} = 6$, the ratio required.

Fig. 7 shows the space swept out by the tangent portion of the belt in a complete revolution, four portions being swept twice, and a space in the centre being untouched, which in this case is an ellipse. Its major diameter = diameter of even pulley; minor diameter = diameter of whole belt, less distance between centres.

If 40 = radius of even pulleys and 100 = distance,

major = 80.

$$\text{Minor} = 80 + \frac{200}{3{\cdot}1416} - 100 = 43{\cdot}66,$$

to which scale the figure is drawn.

WHAT ELECTRIC LIGHTING REALLY COSTS.

(*Continued from page* 647.)

One of the greatest difficulties in securing actual costs of electric lighting arises from the fact that consumers are somewhat prone to make out to the suppliers that the cost is excessive. One company, in reply to our inquiry, states that :—"We have strong reasons to suppose that our consumers generally do not find the cost of electric light much in excess of that of gas, but they are mostly particularly anxious to impress upon us that the cost is very high, and that we must reduce our prices." Fortunately this feeling does not prevail everywhere, and at Scarborough we find well-authenticated cases where the cost of electricity compares favourably with gas; indeed, Scarborough consumers have expressed their surprise at finding so little difference in the annual cost of the two illuminants. It ought to be remarked here that in few cases have we been able to secure the exact number of gas burners that have been displaced by electric lamps; but we may take it as a general rule that when electricity is substituted for gas, there is no tendency to use less light—indeed, experience shows quite the contrary. To return, however, to particular instances: at Scarborough, the most noteworthy one is that of a large grocer, and one could not do better than give the actual statement made by him to the Scarborough Electric Lighting Company :—

20 and 21, Westborough, Scarborough,
16-3-1896.

Dear Sir,—We send you, as requested, the following particulars of the cost of gas and electric light at 20 and 21, Westborough :—

	£	s.	d.
Cost of gas, 1891	38	7	11
Cost of gas, 1892	34	5	2
Cost of gas, 1893	36	6	9
Cost of gas, 1895	8	12	6
Cost of electric light, 1895	20	15	6
	29	8	0

We have 55 electric lights varying from 8 to 32 candle-power. Our premises are quite as well lighted now as previously with gas, though we have not increased the brilliancy. We have also added a gas stove since putting in the electric light. The figures include the gas used for a small engine, gas stove, and two gas rings; practically, we have no gas for illuminating. This shows an average saving of over £5 10s. per year. We attribute it very largely to

the care taken in not leaving the lights on when not required. Mr. Alderson-Smith is at liberty to make use of these figures if they are of any service to him.—Yours, &c.

(Signed) Geo. Rowntree.

To Mr. G. S. Peck, resident engineer, Scarborough Electric Company, 102, Westborough.

To take another seaside town, Hastings, the results of inquiries are equally satisfactory. Mr. Duff, of Highbury House School, had 150 gas jets of various types replaced with a corresponding number of electric lamps. In the course of a communication to Mr. Andrews, the engineer and manager to the Hastings and St. Leonard's Electric Light Company, Limited, Mr. Duff says: "The simple fact remains that the cost of lighting the premises during the first six months of 1896 with the new illuminant and the old combined has been less than with the gas only in 1895 over the same period, and this in spite of having to pay for meters for both means of lighting this year, which represents an addition of 7s. 6d. to the cost." Mr. Andrews, in the course of careful inquiries, has found that 51 per cent. of their customers, using between them 4,860 8-candle-power lamps, have testified that they consider electricity to be quite as cheap as gas; that they have no complaints to make about their supply, and that they have no reason to regret having had it installed; 8½ per cent. consider it dearer than gas; 4 per cent. have complaints to make; and under 2 per cent. regret having had it installed. From the remainder, replies have not yet been received. Nearly all complaints have been traced to the following causes:—1. The use of lamps of unsuitable size. 2. Bad arrangement of lamps. 3. Continued use of old and blackened lamps.

Mr. W. Howard Tasker has been good enough to place at our disposal figures showing the cost of lighting St. Peter's Church, Eaton Square, for a year. The method of lighting was devised and superintended by Mr. Howard Tasker, and we may depend upon it that the place is better lighted than it was previously by gas, although fewer burners are actually used. There is probably a better distribution of light than formerly, and less waste. 32 C.P. glow lamps are confined to the nave lighting, the 16 C.P. are disposed throughout the remainder of the Church, Lady Chapel, Clergy, and Choir Vestries and Portico, and 18 C.P. lamps do duty at organ, on pulpit stairs, and in passages, lavatories, &c. The results are practically that, while 644 gas burners cost £123 7s. 7d. per annum, 262 glow lamps, equivalent to 560 8-C.P. lamps, cost £99 8s. 6d. That is to say, St. Peter's Church is now better lighted, and costs £24 less than it did previously under the *régime* of gas. We need hardly expatiate upon the improvement that must have been effected by adopting electricity, both on decorations, and in the feelings of the members of the congregation. We feel sure that no one will think harshly of us for mentioning so near St. Peter's Church, the case of a public-house in Lancaster, where the previous amount of gas bill was £7 9s. 4d., and where now the electricity bill is £4 2s. 11d., and the amount of gas burned costing 1s. 9d. per annum.

(*To be continued.*)

CORRESPONDENCE.

The "Jandus" Lamp.

We intended to let Messrs. Korting & Mathiesen's last letter pass unanswered, but as some of our friends are of opinion that silence may be misconstrued, perhaps you will allow us to add a few lines.

The only point of interest is the fact that Messrs. Korting and Mathiesen now appear in their true colours as lamp manufacturers criticising a rival's wares.

We cannot think that you, Mr. Editor, would have published their report at all if this had been clear to you in the first instance.

We have no wish to weary your readers by wrangling over details, but we may just inform Messrs. Korting and Mathiesen that although the lamps would burn badly if put together out of centre the life of the carbons would not be affected by this.

We note that they now modify their views as to the possibility of an alternating lamp with enclosed globes; if they will ask their London agent to call he can see the lamp burning without external choking coil on 100 volt alternating circuit.

Finally, although Messrs. Korting & Mathiesen may now be satisfied with their business in open arc lamps, we will venture to prophesy that within the next two years they will either have materially altered their views, or have dropped altogether out of the lamp market.

Is it possible that their recent permission to their London agent to purchase our lamps, and his promise within the last few days to order 36 lamps has any significance?

Drake & Gorham.

Re McDonald Primary Cell.

There is one statement I should like to make *re* my test of the McDonald cell, mentioned in last Friday's issue, viz.: Dr. Peddie used salt and water in porous cell in his test, I myself used diluted acid, s.g. 1,100, also a cylindrical zinc in place of ordinary flat zinc; this accounts for increase in current and constancy.

E. A. McLachlan.

[More than ever does that pamphlet want overhauling! Mr. McLachlan's combination of metals and liquids after a short time of working is that of the Daniell pure and simple; dilute sulphuric acid and zinc, sulphate of copper and copper; it is no longer a primitive McDonald element. What will Mr. Urquhart say to this?—Eds. Elec. Rev.]

Machine Telegraphy.

Permit me to supplement the information you have obtained from the Franklin Institute *Journal* about my system of machine telegraphy with some particulars which, had they been known to you earlier, might, perhaps, have modified some of the conclusions reached in your notice of October 16th.

You start out by saying that my system "is an ingenious combination of devices which are already in use or have been tried or abandoned in such systems as the Wheatstone and Bain."

Might you not as well say of the Wheatstone system that it is an ingenious combination of devices in use, tried or abandoned, such as perforated tape, current, magnetism, and ink? Bain was not the discoverer of electrolytic marking, nor did Wheatstone invent transmission by perforated tape. My perforator, transmitter, and receiver are all new. They have never been tried except by myself, have not been abandoned, and are not in use in any system but my own at present. Discoveries are rare, and if improvement in industrial arts or sciences waited on them advancement would be exceedingly slow. Electric traction, electric lighting, telephony, and duplex telegraphy were tried and abandoned many years before their introduction commercially, and, so far as I am aware, their practical perfection came about by ingenious combination of devices in use, tried or abandoned. Even the Wheatstone system was a very poor affair up to about ten years ago, when by ingenious combination of well known devices on the part of Mr. Preece and his able assistants the speed was trebled.

The committee's report of the conditions attending the trial over the commercial line is rather meagre as to particulars, and as the report was your only guide, some of your deductions are easily accounted for. The circuit was made up of 193 miles of copper wire, 130 lbs. to the mile, and 25 miles of iron wire, total resistance about 1,800 ohms. 115 volts were used. Owing to interruption to several other wires, there was no time for accurate tests to determine whether some of the dozen or more intermediate offices had complied with the order to "cut out," but the chances are that one or two remained out of Yankee curiosity to see what was going on. Under these circumstances 940 words per minute plainly recorded was considered good work. Your criticism of the committee's view of the effects of the weather conditions prevailing at the time is well taken, so far as clearing of the line is concerned, but the committee doubtless appreciating the fact that owing to the method of differentiating the dots from the dashes, the effects of static capacity on an ordinary circuit could be practically ignored, considered the great percentage of current loss more important in the matter of plain

fast signalling over such a circuit. With 250 volts as employed for quadruplex working, the speed could have been doubled. The weather could not have been more favourable for leakage between wires on the same poles, and although there were a dozen or more, the difficulties which you describe as fatal to the Bain system was not observable in the slightest degree.

Now, as to experimental speeds, I quite agree with you that they should not count for very much, but important information may be obtained from such experiments nevertheless. To know that, apart from line effects, the Wheatstone system can be made to work up to 600 words per minute is very interesting, for it means nearly 200 excursions of the armature per second. Marvellous as this undoubtedly is for a relay, it is very slow compared with the speed obtainable by the chemical system. Since the Franklin Institute examination, I have made important progress in the direction of high speeds. I enclose you a specimen* of the received record transmitted at 8,000 words per minute through an artificial line of 250 ohms, 2·95 mf. with 115 volts. This amounts to approximately 2,600 impulses per second, and required the perforated tape to pass through the transmitter at the rate of 27 feet per second. Such a speed would be impracticable for regular work, but it proves two very important things, viz., the great superiority of my transmitter, and the unapproachable recording speed attainable with sensitive paper when the dots and dashes are separated into different lines.

The objection that mine is essentially a single current system, and that, therefore, the receiving apparatus is open to the reception of stray currents, is evidently based upon the experience referred to with the Wheatstone system. The cases are not analogous, for even in the absence of stray currents it is next to impossible to prevent a polarised relay of minimum time constant from chattering if left without current, especially when, owing to high speed, the bias of the armature from exact neutrality is necessarily very slight. With chemical recording, however, it is quite different. Unless the stray currents are sufficiently powerful to make a plain mark on the paper, they can do no harm. There is no chattering, no clipping, no dropping of dots, and nothing short of a radical change in the circuit will cause a loss of signals. They may be fainter, but they will all be there.

The length of this communication already admits of but brief reference to two other points which you raise against my system. One, that the perforated tape cannot be used for retransmission over other circuits as many times as the Wheatstone tape. I have never tried the latter in this way, but I have used my own tape over 100 times before it showed signs of wear.

The other objection that the chemical paper is difficult to handle, and must be kept moist to exactly the right degree, may have been a valid objection to the Bain system, but I must ask you to take my word for it that progress has been made, and that Bain's crude system of 50 years ago is not a true standard by which to measure the merits of recent improvements. The receiving tape of to-day comes loosely wound from the manufacturer. It is dropped in its entirety into the sensitive solution, and, after a few hours soaking, during which the expansion has made it perfectly solid, it is put away for use in stone jars, and will remain in good condition for six weeks. I have obtained fairly good signals with tape four months old.

Formerly, there was great danger of breaking the receiving tape by suddenly starting the machine. This difficulty has been entirely overcome. An instantaneous start at 20 feet per second is possible. There is perfect control between the sender and receiver. When the transmitting tape has passed through the machine, the receiving instrument is automatically stopped. It is also *started* by the transmitter, and the receiving operator can stop the transmitting instrument at any stage, so that there is no waste of time or tape.

I estimate that with copper wires of about five ohms per mile, such as is now generally used, good signals can be obtained at from 1,000 to 3,000 words per minute over distances of from 100 to 500 miles, and that with a wire of 850 lbs., or, say an ohm per mile wire, 1,000 words per minute can be recorded over a circuit of 1,000 miles.

Patrick B. Delany.

South Orange, N.J.,
November 9th, 1896.

* The specimen which Mr. Delany has sent is an excellent one. The clearness and spacing of the record is noteworthy. The slip, however, does not agree with the MS., for the 250 ohms given above are stated on the record to be 650.

We have read Mr. Delany's letter with interest, and we think that it sets forth a stronger case in favour of his system, than does the Committee's Report, chiefly because it deals more definitely and decidedly with some of the actual difficulties which have to be faced in high speed telegraphy. Some of the reasons stated in the report were, in our opinion, weak, and were accordingly mildly criticised. We are still of opinion that it is incorrect to describe the only practical trial referred to as being conducted "under the most unfavourable atmospheric conditions," because it was raining throughout the entire length of the time, and we think that with *any* high speed system such a state of affairs must be considered favourable rather than otherwise. In addition to the advantages attendant upon the quicker discharging of the line, it must be remembered that when rain falls "in torrents" the insulators are washed clean, and even though the arms are not "earth-wired," the leakage from wire to wire is generally less than when the weather is merely "damp." We have again read the report, and we still hold the opinion that several of the reasons given for the awarding of the medal do not do justice to the members of the Committee as "experts in high speed telegraphy."

One great advantage of the double current system is that when signals are being transmitted, the armature of the receiving apparatus is always held decidedly to the spacing or to the marking side, and that consequently stray currents do not affect the signals until they are nearly or quite equal in strength to the working current. It is quite true, as Mr. Delany states, that the instrument usually "chatters" when no working current is being transmitted, and the better the instrument and its adjustment, the more so is this the case; but it is not a serious matter, as the stray currents cannot be mistaken for the proper signals, and the effect is only observable when the line is idle.

We stated that Mr. Delany's system is essentially a single current one, because it appears to us that in the intervals between signals, letters, and words, the line is disconnected at the sending end and joined through the prepared paper at the receiving end, in just the manner which would allow stray currents to produce stray signals. The Bain system although introduced 50 years ago, has been experimented with frequently since then, and Mr. Delany is to be congratulated if he has overcome the many difficulties inherent thereto. It is certainly sensitive, and, therefore, liable to record even feeble stray currents. The device of changing the position instead of the length of the signals tends to reduce errors in reading due to stray currents, but it cannot entirely obviate it. This device is, to our mind, the most important of the whole system, and it was fully appreciated in the article. There is no doubt, also, that such a simple type of transmitter possesses considerable advantages on account of the absence of the usual mechanism, if the signals can be transmitted with equal certainty. Only lengthy experience in actual work can determine the real value of such a system, and should it prove superior to others now in use, no one will be more gratified than

The Writers of the Article.

The Late Sir Benjamin Ward Richardson and Living Burial.

With reference to "A Sure Test for Death," published in the ELECTRICAL REVIEW, November 20th, I should like to make a few observations. The lamented death of Sir Benjamin Ward Richardson removes from our midst an enlightened physician, sanitarian, and *littérateur* who could ill

be spared. Sir Benjamin was one of the few medical men who had devoted attention to the highly important and pressing question of the simulacra of death and its attending dangers. On page 75 of "Premature Burial, and How it may be Prevented," the authors say:—"Dr. B. W. Richardson quotes a case in the *Lancet*, 1888, Vol. ii., p. 1179, of a man who, in 1869, was rendered cataleptic by a lightning stroke, and who narrowly escaped living burial." Other allusions to the learned physician's opinion are made in this volume, and on pages 188—191 a curious case is related showing the proper value of the diaphanous test, which physicians are apt to regard as infallible. It appears that a lady, 73 years of age, died from chronic bronchitis; there was no doubt of this fact in the mind of the attending doctor, but the patient having previously recovered from a death-like condition, and having always been in dread of being buried alive, to please the relatives, Sir B. W. Richardson was summoned. The latter submitted the body to all the tests of death, including the diaphanous test referred to in your excellent journal, which, to their surprise, exhibited the scarlet line of light (the blood was found in a fluid condition). The writer says: "The results of these experimental tests were satisfactory, as following and corroborating each other in eight out of the 10 different lines of procedure; but the point of my paper is to show the utter inadequacy of the diaphanous test, upon which some are inclined entirely to rely. Sir Benjamin Richardson has reported an instance in which the test applied to the hand of a lady who had simply fainted gave no evidence of the red line; she, therefore, on that test alone, might have been declared dead. In my case the reverse was presented; the body was dead, whilst the red line supposed to indicate life was visible. Hence the test might possibly lead to a double error, and ought never of itself to be relied on." With all due respect to Dr. Hugo Engel, the only infallible sign of death at present known to science is putrefaction. It is to be hoped that any manuscript relating to the subject of premature interment and its prevention, or the signs of death, left amongst the papers of the late Sir B. W. Richardson, may be edited and published for the sake of the ever widening circle of readers who trusted the judgment of one whose researches in science were directed for the benefit and happiness of the human race.

Jas. R. Williamson.

42, Stibbington Street, London, N.W.
November 30th, 1896.

Leyton Electric Lighting Works.

For the information of Mr. T. R. D. Kenny, or others interested, I have pleasure in answering the points raised in his letter published under above heading. The governing is done by the hit or miss arrangement. Mr. Kenny will understand why the battery is connected to the positive and centre, and the motor generator left to take care of the other side, when he hears that there is only one set of batteries (85 cells, not two). On the present arrangement, the transformer has to be run all the time—we have a spare one, if necessary. When the extensions that Prof. Robinson is now carrying on are finished, there will be another set of batteries equal to the one now in, and the arrangement will be altered to the following:—The 170 cells of battery will be in series, and during discharge will be connected across the outers and also to the middle wire. There will be regulating switches on the middle and negative ends, so that the pressure can be kept equal on both sides. We can then shut down the transformers altogether. As our dynamo pressure is from 300 to 350 volts, it will be seen that we should be unable to charge the battery in series, so at time of charging 40 cells from the positive end will be cut out and placed in parallel with 40 of the remaining cells, and during charge the middle wire will be cut off the battery altogether, the balancing of the system being done by the transformers only. The 40 cells, which are put in parallel with the others, will have a throw-over switch, so that they can be placed at either end of the battery.

H. Collings Bishop.

Leyton, *November 30th*.

"Fusion of Electric Wires," and the Cause.

As no comment has appeared in the ELECTRICAL REVIEW upon the recent reports in several of our leading daily papers as to the cause of the fire at St. George's Church, Hanover Square, on the 18th ult., I assume there may be some reasonable grounds for silence, and, doubtless, is wise, until the matter has been thoroughly investigated. In the meantime, the mention "of the fusing of wires," as stated to be the cause, is not a little misleading, and may cause unnecessary alarm to some using electricity, and, possibly, prevent others who have already entertained, or have been impressed with the many advantages in its favour, and to none perhaps more than those responsible for the lighting of public buildings, and especially churches, a feeling of doubt and insecurity may result, and it would not be an easy task to convince many of the impossibility of such an accident to happen in a properly wired building, where the current is carefully regulated. This can be done only by electrical engineers who have had the necessary training, and are aware of the result of using unsuitable material and bad work. Whoever accepts the lowest tender for work to be done should not expect same efficiency, as when a slightly advanced price is given, and is no guarantee the work or material will be the same at a low price. Fair remuneration should be given to secure good work and best material; this will reduce the causes and prevent accidents, help to stimulate improvements in insulation of conductors, stoneware and porcelain casings may take place of wood, greater security against fire and accidents will be thereby attained. Even this would not do away with the necessity of occasionally, at not too long intervals of carefully testing the whole installation, examining terminals which may work loose and develop heat from expansion and contraction, switches carefully cleaned, as metallic dust does collect. Gas requires some attention even in new fittings, escapes are soon detected and stopped, and nothing thought of it. But electric current does not show such clear indications to consumer, hence the necessity of tests, either by the supply company's or private electrical engineer. Fusing of wires will then be unheard of—and safety ensured.

G. N.

Induction in Multiple Core Cables.

In the ELECTRICAL REVIEW, May 2nd and 22nd, 1891, Mr. Gulstad and I published two articles, entitled, "Remarks on Induction in Multiple Core Cables." The second article contains the following passage (page 643):—". . . . We suggest, in order to remedy the induction altogether, to cover each core with a metallic sheathing of some kind, carefully earthed, or, better still, connected to the outer sheathing of the cable throughout its length. It is, however, clear that such a metallic sheathing, spirally-wound round each core, would have to be of exactly the same kind as the one forming the armature, as otherwise electrolytic action would destroy one of them; in case of tinfoil being employed for the purpose, the iron wire would have to be tinned." . . .

The idea here originated and meant as a practical remedy against disturbances from wire to wire, caused by electrostatic induction, was then quite new as regards submarine telegraph cables, but well known and in use in connection with aerial telephone cables (for instance, Messrs. Felten and Guilleaume's, of Mülheim-on-Rhine).

It is therefore very gratifying to us to learn that this idea has been put into practical use, and proved of great advantage on the *new Bacton-Borkum cable*.

P. Chr. Dresing.

Copenhagen, *December 1st*, 1896.

A Disclaimer.

As statements relating to the British Motor Syndicate, Limited, have appeared in numerous papers which are misleading to the public, and may be of injury to me if the readiest inference from them is not contradicted, I beg you will allow me to say that the reference to my name coupled with the *Engineer* was without my knowledge or authority. The owners of the patents which were bought from*
for the British Motor Syndicate or the Great Horseless Carriage Company are, of course, free to publish the fact of their ownership, but the publication should be in a form

* A word is here left out in Mr. Beaumont's typewritten original. We presume it is intended to read "bought from me, &c."—EDS. ELEC. REV.

unobjectionable to the patentee. The purchase above referred to having been settled, I have no interest in the Syndicate or any other motor vehicle company beyond that of any engineer who takes particular interest in the subject of motor vehicles of all kinds, and in the inventions concerning them. With regard to the reference to my editorial connection with the *Engineer*, which has been made the subject of notices by advertisement, I would like to be allowed to state that my resignation took place in July, in consequence of pressure of private practice, and therefore had no reference, as might be implied from the words used in the notices to which I allude, to the British Motor Syndicate.

W. Worby Beaumont.

INTERNATIONAL SUBMARINE TELEGRAPH MEMORIAL.

A meeting of the full Committee was held at Winchester House last Friday, when the Marquis of Tweeddale presided. The chairman said they had met to receive the report of the Executive Committee, which had resolved, subject to confirmation:—

1. That a bust of the late Sir John Pender, at a cost not to exceed £500, be erected in the Imperial Institute, or other suitable place;

2. That a sum of not less than £5,000 be placed in trust with the Council of University College, London, to form an endowment fund for the maintenance of the Electrical Laboratory in that College, on the condition that the Council name the Laboratory the "Pender Laboratory," and the existing Chair of Electrical Engineering the "Pender Chair of Electrical Engineering;"

3. To endow a "Pender" Scholarship in connection with Electricity at Glasgow.

They had received 33 replies in approval of the scheme, while one or two had objected to certain clauses. The Lord Provost of Edinburgh had written pointing out that he would like to see the word Edinburgh inserted instead of Glasgow. With regard to that, if their funds were pretty substantial, the claims of Edinburgh would be considered by the Committee. He had also received a letter from Lord Kelvin, in which he suggested in Clause 3 the addition of the words, "or a scholarship and medal." The addition of the word medal was suggested, in order that the medal that was given by Sir John Pender should be continued in Glasgow.

Mr. Underdown, Q.C., moved that Lord Kelvin's suggestion be added to the resolution, and Mr. Charles Bright seconded.

The resolutions of the executive were then moved by the Marquis of Tweeddale, and seconded by Mr. J. C. Lamb, and carried.

The Marquis of Tweeddale said the Committee were under great obligations to Mr. Lamb and Mr. Von Chauvin, for the trouble they had taken in meeting the points raised as to the propriety of setting aside £5,000.

A question being asked as to what steps had been taken to invite public subscriptions, the Marquis of Tweeddale said a draft letter would be sent out bearing his signature.

The three resolutions would form part of the letter, which concluded as follows:—"Although submarine telegraphy has remained from the first almost exclusively a British enterprise and industry, it has always been international in its character and benefits; and I do not doubt that you will consider well worthy of your support this proposed commemoration in connexion with so wide-reaching an agency for the progress and drawing together of the nations, and especially of Great Britain and her colonies. All donations will be publicly acknowledged." Several of the companies had been approached, and some of them had responded with handsome subscriptions, while sums had also been received from shareholders, members of the committee, and others. The least they hoped to receive was £10,000. After the Pender memorial had been completed, gentlemen might be invited to join them with a view to carrying out the proposed jubilee memorial in 1901.

Sir George Young said that he desired to state that the council of University College, at their meeting on the previous day, had had before them the matter referred to in the second resolution, and had been much pleased at what was proposed. He had been desired to state, merely by way of information, that in the case of recent endowments of professorships in the college the amount fixed on as a satisfactory endowment for a professorial chair was a *minimum* of £500 a year. He also desired to point out that an endowment to the University College was in fact an endowment to the University which was about to be established for London; it was not merely a single college, but the teaching University, which was to be constituted by a union of the existing University of London and of the teaching institutions.

A vote of thanks to the chairman brought the meeting to a close.

MOTOR VEHICLES.

Major Flood Page began his address to the London Chamber of Commerce, on Tuesday, by regretting that the Act defined motor vehicles as "light locomotives," and after enumerating half a dozen or so of the many names which such vehicles have received, added another which he considered would be the best, *i.e.*, "automotive." It seems quite unnecessary, now that "autocar" and "motorcar" are becoming so general, that the Major, or anyone else, should trot out a fresh title, and we do not think that "automotive" will "catch on" very quickly. "A rose by any other name would smell as sweet."

The lecturer pointed out one or two regulations in the Act which he thought would be remedied before long, and after considering the probable effect of the "automotive" movement upon commercial life, and upon war methods, he dealt at considerable length with the merits of petroleum, steam and electricity. He quoted from the opinions of Sir David Salomons, Sir Frederick Bramwell, Mr. Worby Beaumont, and Prof. Boverton Redwood. The Major gave each power a very fair hearing. He, however, stood by electricity. Petroleum, he said, was ahead at present; steam had shown itself practicable, and would again; but electricity, the youngest, would certainly advance in this and every other branch of industry. Only those who knew what was going on in electrical work, knew how really great that advance was. In country districts the use of steam and petroleum might be expected, but in towns electricity would probably be employed. He believed that automotives would change the entire face of war—that guns would be moved and all transport work be done by means of automotives, and, further, that there would be batteries of automotives. Two or three years ago they were all anxious about light railways, but who would put down light railways now at a cost of £2,000 or £3,000 a mile, when all the advantages they could give would be afforded by automotives? He strongly impressed upon all the exercise of caution, and trusted that no injury would be done to the movement by wild speculation, reminding them of the millions that were lost by the "rush" on railways and on electric lighting.

In the discussion which followed, Mr. Boverton Redwood, Mr. A. R. Sennett, and Mr. Walter Hancock took part. Several interesting points came out in the course of the discussion. Baron G. de Reuter stated, when considering the merits of the various motive powers, that an electric accumulator is being tried in Germany which not only is 60 per cent. lighter, occupied much less space, and was very much cheaper, but its principal advantage was "that it had no leakage," and "it will have its same potentiality after a long time as it had when first charged."

Mr. George J. Jacobs, the President of the Institution of British Carriage Manufacturers, remarked that when a suitable motive power was decided upon, then the coachbuilder, who aimed at making things of beauty, would turn out something beautiful. The coachbuilder furnished the body, but the engineer must find the soul. In these "automotives," at present, there had not been anything produced which could be called beautiful. [We quite agree with Mr. Jacobs.]

A vote of thanks was given to Major Flood Page for his lecture.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week Ending Dec. 1st, 1895.	£	s.
Alexandria	40	0
Algoa Bay	364	0
Amsterdam	212	0
Bombay	25	0
Buenos Ayres	110	0
" Teleg. mtl.	411	0
Calcutta	32	0
Cape Town	278	0
Colombo...	12	0
Constantinople. Teleg. cable	64	0
Delagoa Bay	1,137	0
East London	25	0
Gothenburg. Teleg. wire	73	0
Hong Kong	13	0
Melbourne	424	0
" Teleg. mtl. ...	100	0
Naples	69	0
Novorossisk	277	0
Passages	467	0
Port Natal	196	0
Shanghai	41	0
Sydney	219	0
Wellington	447	0
Yokohama	160	0
" Teleg. mtl.	176	0
Total	£5,372	0

Week Ending Dec. 1st, 1896.	£	s.
Adelaide	19	0
Albany	60	0
Alexandria. Teleg. mtl.	292	0
Amsterdam	40	0
Antwerp	130	0
Bombay	150	0
Buenos Ayres. Teleg. material	162	0
Calcutta	715	0
Cape Town	1,099	0
Christchurch	18	0
Colombo	7	0
Durban	18	0
" Telephones ...	150	0
East London	2,575	0
Hamburg. Teleg. mtl.	112	0
Hong Kong	132	0
Madras	45	0
Melbourne	21	0
" Teleg. mtl. ...	175	0
Oporto. Teleg. mtl. ...	19	0
Port Elizabeth	20	0
Reval	150	0
St. Petersburg	70	0
Santos. Teleg. mtl. ...	75	0
Shanghai	230	0
Singapore	10	0
" Teleg. mtl. ...	100	0
Sydney	283	0
Trieste. Teleg. mtl. ...	16	0
Wellington	27	0
Yokohama	460	0
Total	£7,380	0

Foreign Goods Transhipped.

Stockholm. Teleph. mtl.	£10	0
Total	£10	0

A Lost Foreign Contract.—Regarding the matter to which we refer in our "Notes" columns, a correspondent writes as follows:—"It is somewhat surprising to learn from a letter published in a morning contemporary that an English firm has probably lost an important foreign contract for the supply of electric lighting plant to a leading continental city. The writer of the letter refrains from citing either the name of the city or the country; but it appears that tenders were invited for the supply of electrical plant, and that the offers were to be personally submitted. The English tender, so the writer tells us, was handed in by the agent of the British firm, but as the representative was unable to convert pounds and yards into the decimal system, this offer could not even be considered! Eventually the contract was placed with a German firm. We fancy that on the result being made known, the agent passed rather a warm quarter of an hour—or, at least, that he received from his employers such a wigging as will last him for many years to come. At the same time, we must express our astonishment—seeing that, with the exception of England and Russia, the decimal system is now universal—that any English firm should think there would be the slightest possibility of competing in English terms with foreigners in any open Continental market.

"Architectural Review."—This is the title of a new sixpenny monthly journal, which commencing with the November issue, is an excellent publication in every respect. It is intended "for the artist and craftsman," and abounds in interesting pictures and articles.

A "Technical Educator."—Messrs. Cassell & Co., Limited, have aimed at supplying a want of the present day in producing a cheap edition (6d.) of their "Technical Educator." This publication is similar in size and appearance to the "Popular Educator." The following titles of articles commenced in the first issue give an idea of the ground to be covered in the 24 numbers:—Steel and iron; projection; cutting tools; plumbing; drawing for carpenters and joiners; electrical engineering, by E. A. O'Keefe; photography; watch and clock making; the steam engine; drawing for engineers; practical mechanics, &c. A coloured plate of the Bessemer process shows "the cast" and "the blow." "Technical education" is dilated upon by Mr. Henry Cunynghame and Mr. W. Ripper. The "Technical Educator" should meet with ample support.

Bankruptcy Proceedings.—The creditors of Mevner, Handford & Co., electrical engineers, &c., of James Street, Westminster, and Brighton Works, Redhill, met by adjournment last Thursday at the London Bankruptcy Court, before Mr. G. W. Chapman, Assistant Receiver. The debtors have contracts on hand for the installation of the electric light at Buckingham Gate Mansions, James Street, Westminster, and the Manhattan Mansions, Holloway. They attribute their failure to bad debts and losses on contracts. Accounts have been filed since the last meeting, showing gross liabilities £4,675 (unsecured, £3,795), and assets, £1,500. No offer was submitted; certain assistance that was promised had been withdrawn in consequence of an opposition business having been started at Redhill since the failure. Mr. R. J. Ward, accountant, was appointed as trustee to administer the estate in bankruptcy with the assistance of a committee of inspection.

A petition was filed by a creditor on October 30th, and a receiving order made on November 26th, in *re* Thomas Maddren, electrician (trading as T. Maddren & Co.), at Cardiff.

Belfast.—The Electric Committee are prepared to take an improver into the electric light station. See our "Official Notices" for details.

Calcium Carbide.—Works have just been started at Lauterbach, near Solothurn, for the manufacture of calcium carbide by a new concern, known as the Schweizerische Calcium-Carbid Fabrik. The new works are under the direction of Dr. Rossel.

Change of Address.—The offices of the Rand Central Electric Works, Limited, have been removed to 20, Bishopsgate Street Within, E.C.

Electro-Medical Instruments.—The fifth edition (October, 1896) of Mr. K. Schall's book on "Electro-Medical Instruments and their Management," and illustrated price list of electro-medical apparatus has been brought to our notice. In the preface it is stated that the physical laws governing the successful application of electricity in medical and surgical science are explained, along with the necessary apparatus and the construction of same; practical hints about the apparatus best suited under special circumstances, and methods for avoiding, detecting, and rectifying faults, are given. The various sections provide, in simple elementary language, explanations of electrical apparatus used in this sort of work. Electro-physics, galvanisation and electrolysis, cautery, Faradisation, Franklinisation, and Röntgen ray apparatus are the chief sections to which interest is added by a number of diagrammatic and other illustrations. The price list portion is very profusely illustrated, and arranges the matter in such a manner that prices can easily be ascertained.

Electrical Engineering in Austria.—A month or so ago it was announced that Herr E. Kolben had severed his connection with the Maschinenfabrik Oerlikon, of Oerlikon, Switzerland. We now learn that Herr Kolben, in conjunction with Herr Carl Bondy, late of Messrs. Kremenezky, Meyer and Co., of Vienna, are establishing works at Vysosan, near Prague. The new firm, which is to be known as Kolben & Co., will manufacture all kinds of electrical plant, and hopes to commence operations early next year.

Fire.—The destructive fire in Forster Square, Bradford, destroyed a large number of Government telephone wires and Post Office cables.

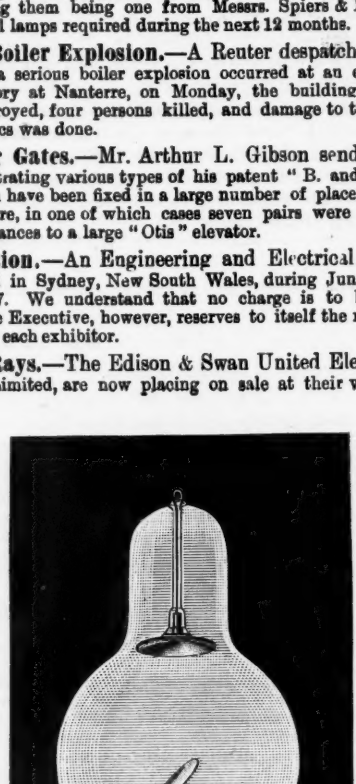
Incandescent Lamps.—The Edison and Swan United Electric Light Company have secured several large contracts for lamps, among them being one from Messrs. Spiers & Pond for the supply of all lamps required during the next 12 months.

Fatal Boiler Explosion.—A Reuter despatch from Paris states that a serious boiler explosion occurred at an electric light carbon factory at Nanterre, on Monday, the building being completely destroyed, four persons killed, and damage to the extent of 450,000 francs was done.

Folding Gates.—Mr. Arthur L. Gibson sends us lithographs illustrating various types of his patent "B. and S." folding gates, which have been fixed in a large number of places in London and elsewhere, in one of which cases seven pairs were fixed to the various entrances to a large "Otis" elevator.

Exhibition.—An Engineering and Electrical Exhibition is to be held in Sydney, New South Wales, during June, July, and August, 1897. We understand that no charge is to be made for space! The Executive, however, reserves to itself the right to limit the space to each exhibitor.

"X" Rays.—The Edison & Swan United Electric Light Company, Limited, are now placing on sale at their various establishments a new X ray focus tube made in various sizes, as shown in the illustration.



ELECTRIC LIGHTING NOTES.

Aberdeen.—A London company has written to the Electric Lighting Committee offering to undertake the up-keep of the batteries at the electric station on payment of a certain sum. The engineer reported that the batteries had, on an average, cost more for their up-keep during the time the station had been in operation than the sum mentioned by the company. The committee, however, resolved that before any agreement should be come to, a detailed report on the subject of the maintenance of the batteries should be presented by the engineer.

Blackpool.—The Gas Committee recommends the Electric Lighting Department "not to lay electric light mains within 2 feet of any existing gas mains."

Blyth.—A number of the arc lamps which have been erected on the shipping staiths at Blyth and various places on the sides of the river by the North-Eastern Railway Company were, on 25th ult., lighted for the first time.

Bristol.—Residents and business people in Queen Charlotte Street and Queen Square have asked for a supply of current, and the mains are to be extended there.

Bradford.—The Gas and Electricity Committee has referred the question of penny-in-the-slot meters for electric lighting to the electrical engineer, Mr. Gibbings.

Brynmenin.—By an arrangement with a local company, the streets are lit with electric light on one side of the river, and lamps (oil?) on the other side.

Cambuslang.—The question of lighting this town in Lanarkshire by electricity is under consideration.

Chelsea.—The Surveyor is to report on the cost of experimentally lighting Oakley Street by electricity, the present standards being utilised if possible.

Distillery Lighting.—The Benrinnes Distillery has just been fitted up with an electric light installation by Messrs. Hamilton and Co. The whole of the buildings, including the maltings, cooperage, offices, stables, &c., are so lighted.

Edinburgh.—The electric lighting of the General Post Office here has just been completed by Messrs. Wm. Barton & Sons, who have put down 36 2,000-C.P. Brockie-Pell double carbon arcs and 540 incandescents. The arc lamps are four in series, on a 230-volt circuit. The buildings are wired for 460 volts.

At the last Council meeting Mr. Mackenzie moved, and it was agreed to remit the question of procuring new machiney for next year to the Electric Lighting Committee, with powers to obtain estimates, and report. Mr. Mackenzie said they had difficulty in getting machinery, and must go into the field at an earlier date and look further forward than ever they did before. They began on April 11th, 1895, with 48 customers, having 2,200 lamps joined on. The number of consumers on May 15th this year was 453, and 58,600 lamps were connected. Since May 15th till the present date the number of consumers had increased to 732, and the number of lamps connected at the present time was 82,830. They had other 6,291 applied for, and they would be joined on as soon as they were ready. That brought them up to 90,000 after little more than 18 months. From May 26th till November 26th last year they had sold 308,280 units; during the corresponding period of this year they sold 605,126, or almost double. Mr. Mackenzie said that if things went on as well as they had been doing, he had no doubt the Council would be justified in a month or two in reducing the rates from 5d. to 4d., and the public lighting from £18 to £16 per annum. Notice was given of motions proposing to extend electric lighting to Regent and Royal Terraces and to Portobello.

Exeter.—Users of electric light have been notified that at present a supply of electricity is given continuously, except between 12 30 a.m. and 6 a.m., but from and after December 10th a supply of electricity will be given during the whole 24 hours.

Extension.—The West Sussex County Council, says *Daily Tenders and Contracts*, have decided to extend the installation of the electric light to Graylingwell Farmhouse, at a cost of £200, and to erect a room for photographing the patients for scientific purposes.

Glasgow.—An official of the Corporation has given warning to the public who are having their premises fitted for electric lighting, to have their installations made perfect, as fires were frequently occurring "through defective lighting installation."

Gorton.—The District Council will oppose any extension of electric lighting in the Council's district by the Manchester Corporation.

Greenwich.—The application by the Blackheath and Greenwich District Electric Light Company, Limited, for a provisional order to supply electricity, &c., has been referred to a Committee of the Board of Works.

Guildford.—The work of laying the cables and erecting engines and dynamos in connection with the Electric Light Company's installation having been completed, the current has been laid on to the premises of the customers. Cables have been laid in the compulsory area of the Board of Trade, and at the works, which are situate at the old militia barracks, machinery capable of meeting all demands for some time to come has been erected. This includes a set of 110 batteries, each capable of supplying 300 lamps for 3½ hours.

Hull.—The question of penny-in-the-slot electricity meters having been introduced by the Electric Light Extension Syndicate, has been referred to a Committee. A deputation of the Electric Lighting Committee is to visit Leeds, Halifax, and Bury, and inspect the electric lighting engines used there. A Sub-Committee is to report on suitable sites for the two sub-stations.

Hoyland.—The District Council is to engage Mr. Hammond to get up a report on the cost of lighting the township by electricity.

India.—Kidderpore Docks are lighted by 60 incandescent lamps, current being supplied from a dynamo driven by a small steam engine.

Killarney.—The Killarney District Lunatic Asylum is now lighted with electricity. On Saturday, 21st ult., the current was turned on, and 400 lights were supplied.

London.—The electric light is to be adopted at Highgate Road Baptist Chapel at an estimated cost for chapel buildings and schools of £125.

London.—The Commissioners of Sewers have instructed the Streets Committee to report on the subject of private lighting, in consequence of consumers' complaints.

Malta.—The electric light installation here was inaugurated by Sir Arthur Lyon Fremantle on 1st inst.

Mill Lighting.—A new woollen mill, just completed at Langholm, is lighted inside and out by electricity.

Monmouth.—The seven tenders sent in for the electric lighting plant for the Council have been referred to the engineers for inspection and report.

Newcastle.—A deputation of the City Lighting Committee visited Edinburgh on Monday to inspect the electric lighting arrangements there.

Portsmouth.—Major Tulloch, R.E., held a Local Government Board inquiry, on Saturday, in connection with the application of the Corporation for sanction to a loan of £16,000 for additional electric lighting works. Mr. Manville said that the demand had increased much beyond expectations; so much so, in fact, that at the present time all three sets of plant had to run together every night, and two nights during the week the whole plant had to be called into operation. Other customers are waiting to be taken on. It is anticipated that with the new plant the revenue (£13,500) will be about doubled. Mr. Manville said the net profit, after making all allowances, was estimated at the rate of about 2½ per cent.

Poplar.—The County of London and Brush Company has been in communication with the District Board respecting the electric lighting powers. The company offers to pay to the Board its expenses incurred in obtaining the provisional order, and to make a contract for public lighting at 3½d. per unit. Question referred to the Dust Destructor Committee. Several members protested against the Board's "dog-in-the-manger" policy.

Provisional Orders.—The following applications for electric lighting powers were notified in the *London Gazette* for Friday last, November 27th:—

Bexhill Urban District Council, for electrically lighting the district.
Droylsden Urban District Council, for electrically lighting the district.
Dudley Corporation, for electrically lighting the borough.
Kearsley Urban District Council, for electrically lighting the district.
Leatherhead Electric Lighting and Power Company, for electrically lighting the district.
Levenshulme Urban District Council, for electrically lighting the district.
Morley Corporation, for electrically lighting the borough.
Morecambe Urban District Council, for electrically lighting the district.
Newmarket Urban District Council, for electrically lighting the district.
Ramsbottom Urban District Council, for electrically lighting the district.
Rottingdean Electric Lighting and Power Company, Limited, for electrically lighting the townships of Rottingdean, Ovingdean, and Woodendean, in the County of Sussex.
Swadlincote Urban District Council, for electrically lighting the district.
Tuxford, power to form a company to construct gas works for lighting the district, also application for an electric lighting license.
Wallasey Urban District Council, for electrically lighting the district.
Walton-on-Thames Electric Lighting and Power Company, for electrically lighting the townships of Walton-on-Thames, Hersham, and Oatlands.

Quarry Lighting.—Some days ago the electric light was turned on at the Threlkeld Granite Quarries for the first time, and well lighted the hill side. The plant comprises steam engine and dynamo combined, capable of giving 12,000 C.P. The exterior of the works is lighted with seven 1,000 C.P. arc lamps, and the interior with 16 C.P. incandescents. The erection was under the supervision of Mr. W. Borlase, electrical engineer.

Saltcoats.—A deputation from the Saltcoats Commissioners visited Ayr electricity works last week, and after conferring with the electrical engineer (Mr. Pink), that gentleman was requested to report on the advisability of introducing the electric light at Saltcoats. The Ayrshire Electricity Committee has given Mr. Pink permission to do so.

Simla.—It is probable, says *Indian Engineering*, that the electric lighting of Simla will be worked by power obtained from the Sutlej. The tenders have been made over to Mr. Macdonald, executive engineer of the Simla Provincial Division, to report. Some eight or nine firms examined the proposals of the committee, and sent experts to examine the locality, and report upon the scheme. Only two firms, however, as already stated, sent in tenders.

St. Helens.—The Corporation installation is now completed, and on Monday supply will commence to consumers' premises. The cost of the works and plant was about £10,000. The manager of the Corporation gas and lighting department, Mr. Samuel Glover, supervised the erection, under the consulting engineership of Mr. Robt. Hammond.

West Ham.—The electrical engineer reports in favour of free wiring, and the Council has approved the principle.

South Africa.—The following notes regarding electrical matters appear in the December number of the *British and South African Export Gazette*:—It is the intention of the directors of the Bantjes Consolidated to double the electric lighting plant which is now being installed on their property, and to put down electric tramways similar to those on the Crown Reef mine. The whole of the electrical work on this property is, we believe, being carried out by Mr. J. Hubert Davies, electrical engineer, Johannesburg.—An electric motor has been ordered for the pumping plant on the Roodepoort Deep mine.—A duplicate of the present electric lighting plant in Durban, is now under order in England.—Messrs. Siemens & Halske have secured the contract for the supply and erection of the additional electric lighting plant for Johannesburg. Their tender amounted to £34,312. The Rand Electric Company obtained the contract to supply the cement. It is estimated that 19,000 8-candle-power lamps will be required for this work.—A large electric lighting installation is to be ordered for the New Club and South African Investment Company's buildings, Johannesburg, the designs for which have just been approved.—The Kimberley Town Council will have a large order for electric lighting plant to give out at an early date. The proposed scheme for the electric lighting of dwelling houses and stores is estimated to cost about £13,000.—An electrical pumping plant is at present under order for the Simmer and Jack mine.—We understand that tenders will be called for the electric lighting of Maritzburg immediately.

Torquay.—A Plymouth paper gives the following particulars about the tenders sent in for electric lighting:—In all there were 76 tenders from 48 firms. Twelve tenders, ranging from £2,303 to £4,999, were received for boiler house plant, and that of Messrs. Babcock & Wilcox, Limited, was accepted for £2,303. Eight tenders, ranging from £7,455 12s. to £11,729 were received for engine house plant. That of Easton, Anderson & Goolden, Limited, for £8,233, with Willans engines, was adopted. For mains, switchboard, instruments, &c, there were 10 tenders, ranging from £563 to £892. That adopted was S. Z. de Ferranti, Limited, for £706 3s. Seven tenders, ranging from £7,165 3s. 6d. to £9,216, were received for street works, arc lamps, and cables. That of the British Insulated Wire Company, Limited, for £7,165 3s. 6d. was adopted. Of the 13 tenders for transformers, that of Nalder & Hilton, for £796, was approved, with a condition. Five firms tendered for the supply of meters, and nine for accumulators; but neither was accepted, as it was thought desirable to defer them for the present. There were nine tenders, ranging from £109 to £225, for travelling crane, rails, &c., and that of Messrs. Isles, Limited, was approved at the sum of £109. For the buildings three tenders were received. Mr. S. Blatchford's, Torquay, is to be recommended. Exclusive of the building section, however, the tenders provisionally accepted amount to £19,312 6s. 6d., whereas the engineer's estimate was £22,300. The Roads Committee will recommend the Council to accept the tender of Goddard, Massey & Warner, of Nottingham, for the erection of the four-cell refuse destructor, with chimney, &c., at the sum of £4,196 10s., subject to the consent of the Local Government Board being obtained to the necessary loan. There will be a further expenditure, estimated at £2,303 10s., for the provision of the buildings to receive the destructor, boilers, &c., and for the making of an inclined roadway, erection of fencing, &c., and altogether it is recommended that application be made to the Local Government Board to borrow £6,500, the amount of the two tenders. Mr. Garrett's estimate for the destructor was £7,000.

West Australia.—The Legislative Assembly at Perth has passed amendments on the Goldfields Act, allowing persons to carry electric wires and tramways across leases.

West Hartlepool.—The Town Council has decided to send a deputation to several Northern towns to obtain information *re* the electric light.

Willesden.—The Willesden District Council has been conferring with a Hampstead sub-committee with regard to the electric lighting of the High Road, Kilburn. It has been decided by the former body that they do not see their way "to enter into any partnership arrangement."

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Bristol.—The report of the Special Committee of the Corporation upon the question of electric traction has now been made known, and is summarised in the following recommendations to the Town Council:—"That the use of the overhead trolley system of electric traction may, on terms to be arranged, and for a period of five years, be allowed on the tramways in the city, except those in certain portions of the city to be hereafter defined by the Council, power being reserved to the Council to require at any time after the expiration of the said period, the substitution of any improved system which may have been found to be practicable, on giving six months notice. That an extension of the use of the overhead trolley, or any other system of electric traction, on the tramways in the city be allowed, only on condition that the supply of electric current for working new electric tramways in the city be taken from the Corporation. That the consideration of the Bill which the Bristol Tramways and Carriage Company, Limited, intend to promote in the next session be referred to your committee." The Bristol Tramways Company in a rejoinder traverse some of the data on which the report is based, and speak of the five years provision as an obvious impossibility.

Blackpool.—A committee recommends the Council to purchase, by tender, "copper tube conductors" for the tramways in Station Road.

Clontarf.—A Dublin paper understands that so far advanced are the preparations for establishing the electric traction system on the Clontarf tramline of the Dublin United Company, that the contractors will in a few days begin to erect the poles and standards. The site for the power house, whence the motive power will be derived, will be at Clontarf, and advertisements for tenders for the erection of the building will be shortly published. At a later period it is intended to erect a larger power house in the vicinity of the quays.

Dover.—A lengthy report by the Town Clerk and Surveyor on the tramways has been before the Town Council and consideration adjourned. After dealing with horse, steam, oil, and compressed air in the report, gas and electric traction are compared, and in connection therewith we make the following extracts:—"It will be within the recollection of the Committee that some weeks ago a letter was received from the Dover Gas Company, asking permission to tender, in conjunction with the British Gas Traction Company, Limited, for the equipment and working of the tramways. With the view, therefore, of comparing the cost of working a gas, and an electric tramway, we sent to the Dover Gas Company, and the Dover Electricity Supply Company, the particulars and questions set out in schedule 1. These particulars are, of course, not final or binding on you, but, with the exceptions hereinafter stated, they are those that we recommend for your favourable consideration. With the view of enabling you to compare the relative cost of these two systems of traction, we framed the questions on the basis that the contracting company would supply everything, except men to act as conductors, and the laying and maintenance of the permanent way. There was also the additional reason that, in case you determined to adopt either of the answers received as a basis for negotiation, you might think it right to frame a contract on the principle that the contracting company should be made responsible for efficiency in working, without being able to contend that any fault lay with the Corporation. We append the replies received as shown in schedule 1 from (1) The British Gas Traction Company, and (2) The Dover Electricity Supply Company. The comparative cost of establishing the two systems in the manner proposed would be as follows:—

	GAS.	
(*a*)	Cars	£5,600
	Trailers	660
	Machinery	1,750
	Total	£8,010
(*b*)	Cars	£5,250
	Trailers	660
	Machinery	1,750
	Total	£7,660
	ELECTRICITY.	
(*a*)	Cars	£4,620
	Trailers	660
	Line Equipment	7,500
	Total	£12,780
(*b*)	Cars	£4,200
	Trailers	660
	Line Equipment	7,500
	Total	£12,360

"We have not included the cost of permanent way or conductors, which will be the same in both cases.

"The comparative annual cost of the two systems for the (*b*) Cars would be as follows:—

GAS.	
Interest on Loan	£230
Instalment	277
160,000 miles at 6d.	4,000
Total	£4,507
ELECTRICITY.	
Interest on Loan	£371
Instalment	463
160,000 miles at 5d.	3,333
Total	£4,167

showing a saving on electricity of £340 per annum."

The reporters inspected the Blackpool gas tramway, Blackpool and Coventry Electric Tramways. The systems of electric traction now in use are explained in detail, and the conclusion is stated that the overhead electric system is the best adapted for Dover. Mr. R. P. Sellon has reported on that subject, and he sets forth three alternative schemes, and recommends that if the Dover Electricity Supply Company are willing to charge a moderate price (he calculates 3d. per unit), and provide suitable power plant, the Corporation cannot do better than take their supply of electric power from them, and would not be justified in putting down their own plant. With this proposal, he estimates the capital outlay at about £28,000, and the annual expenses at about £5,322.

(*Continued on page* 739.)

THE ELECTRIC LIGHTING OF MANCHESTER.

Since the Manchester Corporation Works were first described in the Electrical Review of July 20th, 1894, progress has been so rapid, and the works have grown to such an extent, that we feel justified in referring to them once more.

It is almost unnecessary to point out that the features which distinguished the Manchester system were the use of five-wire methods of distribution, and, at that time, a novel system of charging for electricity. It is interesting to bear these points in mind when considering the remarkable success that has attended the enterprise of the Corporation of Manchester.

The supply was commenced on July 31st, 1893, and when the accounts for the year ending March, 1894, were made up, it was found that although revenue had only been earned during eight months of the year, it was sufficient to defray all the charges of the undertaking, including interest on loans, provision for sinking fund, &c., to within £210.

The following year the net profits amounted to £5,500, whilst for the year 1895, the price of current having been reduced in the meantime, the excess of income over expenditure amounted to upwards of £11,000.

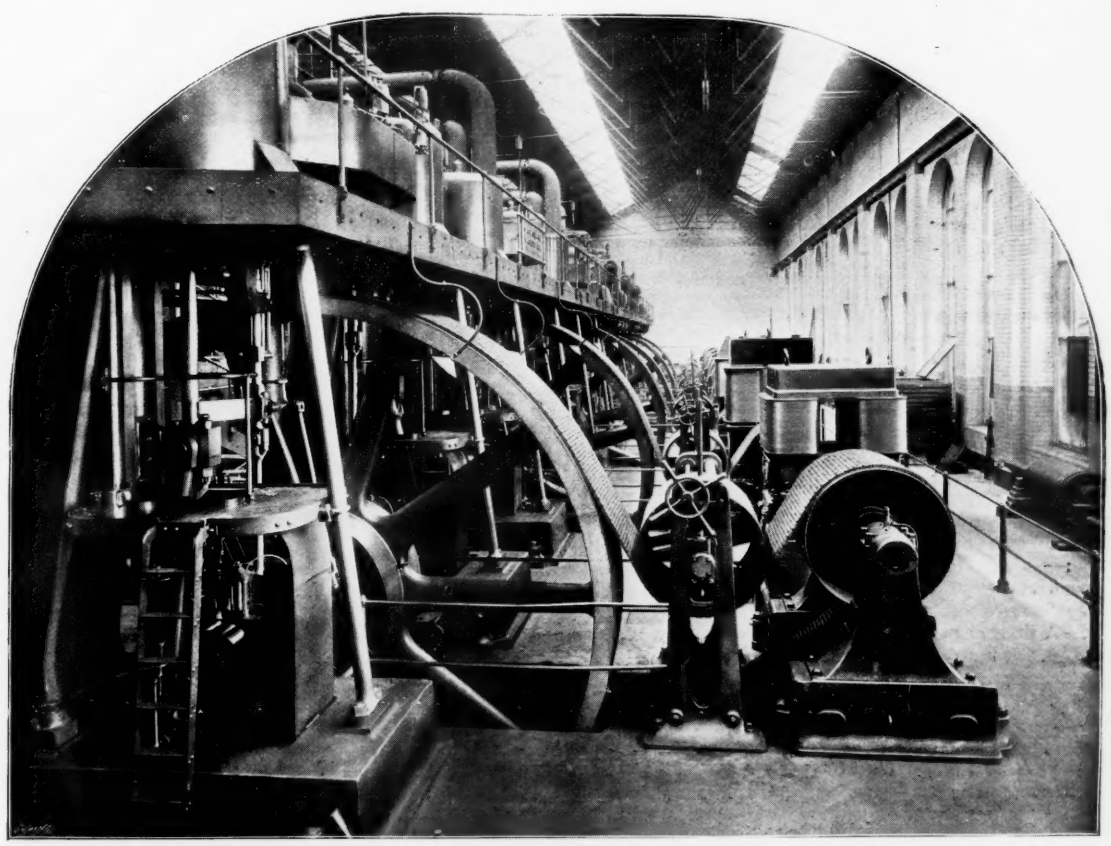
The demand on the part of the public for electric lighting has exceeded all anticipations, and consequently the Corporation have been obliged to increase the capital invested in the works in order to cope with the requirements. Borrowing powers were in the first instance obtained for £80,000, then for £70,000 more; but these sums soon proved to be insufficient, and a further £100,000 was required to be spent in extensive additions to plant and mains.

A new provisional order was obtained this year, empowering the Corporation to supply electric current in the whole of the city area. To give an idea of the extent of this, a diagram has been prepared. On this is shown by a dotted line the extent of the city area, while the central area in practically all streets of which mains are laid, together with recent extensions, is shown in black. The size of the district is approximately seven miles by three miles. This diagram is distinctly interesting, as showing that the problem to be met at Manchester in supplying the whole district is by no means a simple one.

The increase in the demand for current can be seen at a glance from the following table, which shows the number of consumers and lamps connected at the end of each quarter, from the commencement of the undertaking, viz.:—

	Consumers connected.	Lamps connected equivalent in 8 C.P.
1893.—September	82 ...	8,000
December	289 ...	32,716
1894.—March	416 ...	40,000
June	450 ...	43,084
September	509 ...	47,778
December	624 ...	60,298
1895.—March	741 ...	66,914
June	802 ...	74,986
September	863 ...	79,624
December	1,018 ...	93,290
1896.—March	1,148 ...	103,002
June	1,224 ...	111,676
September	1,302 ...	118,618

Yet with all this remarkable growth the demand for the light shows no sign of diminishing. The two lamp diagrams show the rate of increase in two different manners. The first one on page 737, shows the total number of lamps at the end of each fortnight, while the second shows the lamps actually added during each fortnight since the works was started. The actual connections at the present time have the equivalent of 127,472 8-C.P. lamps, which are made up as follows:—Incandescent lamps, equivalent in 8 C.P., 108,696; arc lamps, 971, equivalent in 8 C.P. to 15,359; motors, 103, equivalent to 147 H.P. There is very little doubt that the Corporation of Manchester have done a great deal to extend the use of electric motors on public lighting circuits. Naturally the very favourable terms on which electric energy is supplied for the motive power purposes has had much to do with this. A feature of great importance in the Manchester system is, that large motors can be connected to the system without the slightest effect on the lighting. As a



View of One Side of Manchester Works, Showing Row of Vertical Engines.

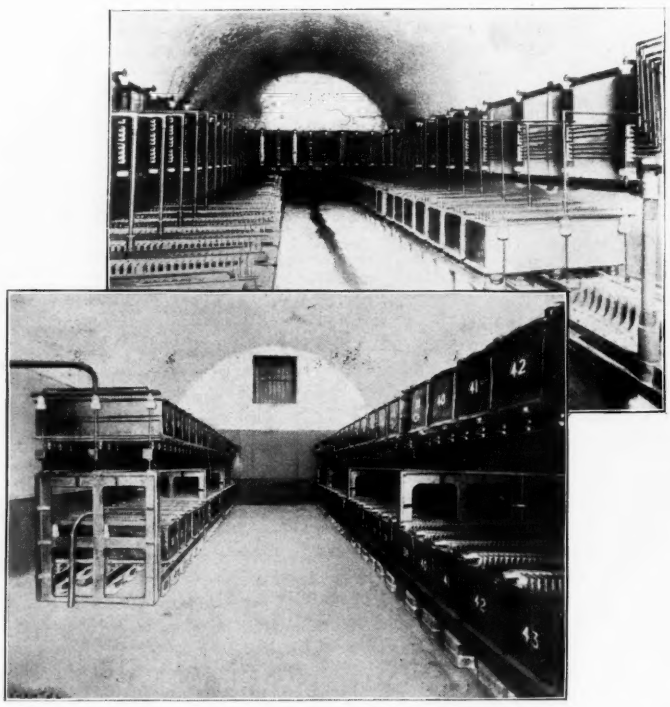
matter of fact, one consumer has a 24 H.P. motor, another two 20-H.P. motors, with every probability of his adding two more of the same size, besides some smaller ones. The larger motors are connected across the two outer mains, and this, no doubt, is the reason why lighting and power supply is carried on without the slightest difficulty. So important a feature is the power supply in industrial Manchester, that several factories employing a large number of hands are entirely dependent upon electric power.

The maximum load on the station at any moment has been about 2,900 kilowatts, and the maximum total output in 24 hours has been about 26,650 units. Of the three load curves that are shown, the first is a normal day, the second a foggy day, and the third a Saturday. The suddenness of the demand on both the foggy day and the normal day is especially interesting in connection with the recent comments on the suitableness of Lancashire boilers for dealing with rapidly fluctuating loads. From a careful and exhaustive examination of the pressure curves we found that no disturbance occurred, a fact which speaks volumes for the watchfulness of Mr. A. A. Day, Mr. Wordingham's chief assistant in the engine room.

Anything connected with the question of charging at Manchester is of importance, and it is interesting to record that of the two charges for current, the one affecting long hour consumers has been reduced by 25 per cent., the charges now being:—

A.—6d. per unit actually consumed.

B.—A fixed charge of £9 per thousand watts demanded, plus 1½d. per unit actually consumed.



View of Regulating Cells and one of the Main Batteries at Hunt's Bank.

Table shewing the Average Cost per Unit with the Fixed Method of Charge, the Fixed Charge being £9 per Annum per 1,000 watts of Maximum Demand, and the Meter Charge being 1½d. per Unit Consumed.

Hours of burning per annum.	Average price per unit in pence.
500	5·82
600	5·1
700	4·59
800	4·2
900	3·9
1,000	3·66
1,200	3·3
1,400	3·04
1,600	2·85
1,800	2·7
2,000	2·58
2,500	2·36
3,000	2·22
3,500	2·12
4,000	2·04
4,500	1·98
5,000	1·93
5,500	1·89
6,000	1·86
6,500	1·83
7,000	1·81
7,500	1·79
8,000	1·77
8,500	1·76
8,760	1·75

This latter rate gives a sliding scale from 6d. to 1¾d. per unit, according to the hours of burning. One could not do better than to give a table showing the various average rates to which method B works out. It might at the first glance be deemed almost impossible for the lower charges to be reached, but on working out any specific case it will be seen that these figures are frequently reached in practice.

Coming, now, to speak of the extensions to generating plant, five 30 feet × 8 feet Lancashire boilers fitted with Vicars mechanical stokers have been put down, also two Green's economisers with 288 tubes each, with a reserve flue between them. The total number of boilers, all of which are exactly similar to one another, is now 12. The coaling floor has been extended, as also has the gantry for the electric coaling crane. The whole of the stokers will in future be driven by means of an electric motor running from the mains, the steam engine formerly employed being connected as a standby. A similar arrangement has also been made for driving the economiser scrapers. There have been added eight 400 H.P. engines and dynamos, six of the engines being vertical, and the remaining two horizontal. The object of fixing the latter was to ascertain whether any of the advantages frequently claimed for this class of engine over the vertical type had any foundation in fact. The vertical engines drive the machines by means of link belts furnished with jockey pulleys, this arrangement having proved very convenient in practice. The engines are similar to those previously fixed, except that they are furnished with Corliss valves instead of slide valves. They were made by Mr. Benjamin Goodfellow, of Hyde.

The high and low pressure cylinders are side by side, and the cranks are placed at right angles to one another on the shaft. The leading dimensions are:—Diameter of high pressure cylinder, 17 inches; diameter of low pressure, 34 inches; length of stroke, 3 feet; number of revolutions per minute, 78.

The two horizontal engines, which are also of 400 I.H.P., are provided with Corliss valves, and have their cylinders side by side. The leading dimensions are:—Diameter of high pressure cylinder, 17 inches; diameter of low pressure, 34 inches; length of stroke, 3 feet; number of revolutions per minute, 85. These two engines drive their dynamos by means of 19 1¼-inch cotton ropes. Steam is supplied at a pressure of 120 lbs. per square inch. Ejector condensers are used in all cases, and are supplied with canal water, which is pumped into the tank over the boiler house by three centrifugal pumps, one of which is driven by an electric motor, and lifts about 3,000 gallons per minute.

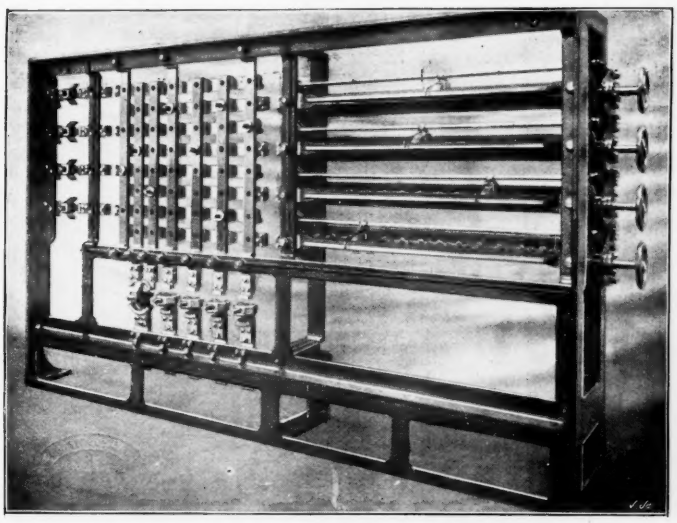
The dynamos, which were made by the Electric Construction Company, have the same output as the machines previously fixed, *i.e.*, 600 amperes at 420 volts, each machine being capable of giving 800 amperes if desired. All the machines were very carefully tested, and after a six hours' run at full load were found to have an efficiency of 96 per cent.

The extensions to the main steam ranges are interesting, as the whole addition to each pipe, 84 feet in length, was put

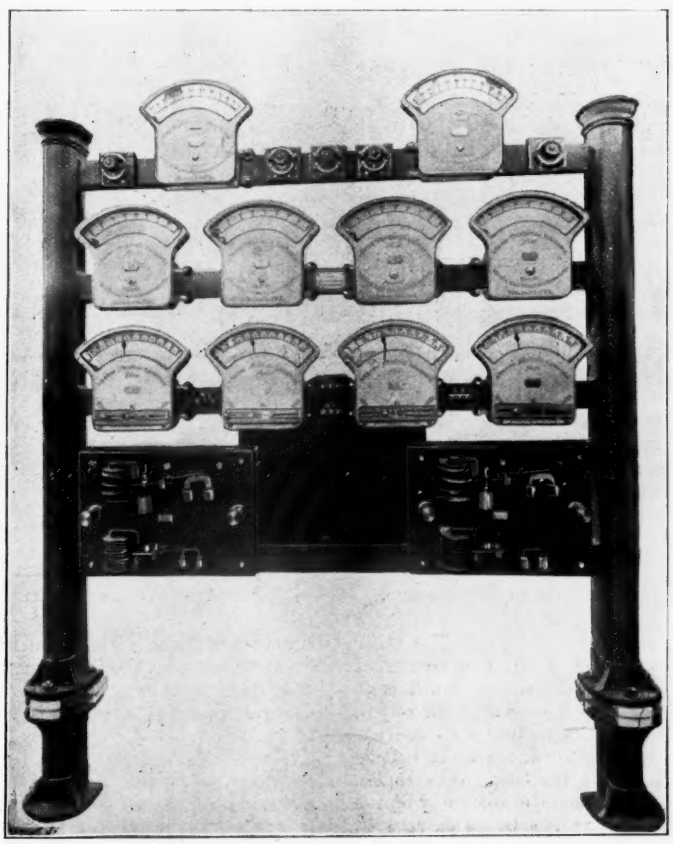
up in one piece, thus avoiding all joints. The advantage of this is difficult to over-estimate in subsequent saving of labour. These steam pipes, together with the new boilers and economisers, were supplied by Messrs. Heaton & Sons, of Holt Town, Manchester.

New switchboards are in course of construction, but are not yet fixed. It is probable that we shall refer to these at a later date.

Very large extensions to the mains have been carried out, the principal streets being the Oxford Road, Stretford Road, and Cavendish Street, London Road, Downing Street and Ardwick Green, and Upper Brook Street, and in addition to these, work is being rapidly pushed on to give a supply of current in Victoria Park before Christmas. Between August, 1894, and the present time, about 96 miles of single conductor have been laid. At the present time the total length of single conductor, including service wires, is about 145 miles. The length of street containing five-wire distributing mains is about 18 miles, and there are $6\frac{1}{2}$ miles of feeders. On a careful examination of a map of the district showing the streets in which mains are laid, we were struck with the capabilities of the five-wire system for serving an extended area. All the mains have been laid by the Electric Light Department's own staff of workmen, under the personal supervision of Mr. Wordingham. For distributors in all cases where the section exceeds $\frac{1}{8}$th square inch, bare copper strip has been used wherever it was possible to obtain room for a culvert. The Crompton system has been used throughout, and an insulation resistance as high as 50 megohms per mile has been obtained in spite of the fact that the culverts had not had time to dry out. Where copper strip was not used, vulcanised India-rubber cables in earthenware pipes, or bitumen cables laid on Callender's solid system, have been employed. All feeders have been continuously insulated, in order to meet the possible contingency of having to raise the pressure on the more distant feeders at a later date.



Battery Switchboard at Hunt's Bank.



Measuring Instruments at Battery Station, Hunt's Bank.

Wordingham patent pillar distributors, which were described in a recent number of the Review, are placed at all important points of intersection, whether the system be five-wire or three-wire. In the extension to Victoria Park mentioned above, the distribution is on a three-wire system with 200 volts pressure at the lamps, the district being wholly residential, and there being no demand for arc lamps or small motors, there appeared to be no objection to using the higher pressure.

To provide for the efficient regulation of pressure, two substations have been constructed, one at the corner of the Cavendish Street and Stretford Road, and the other at the north end of Ardwick Green. Balancing transformers, capable of transferring 150 amperes, have been put down. They are contained in chambers formed under the footway; these chambers are lined with glazed bricks, and lighted by means of deck lights, ventilation being provided for by means of a small electric fan blowing air into the chambers. In accordance with a practice that distinguishes all the Manchester work, great care has been taken to ensure that everything shall be fireproof.

The great feature, however, about the extension of the Manchester system is the adoption of a battery of accumulators, which is probably the largest in the kingdom.

The object of providing a battery was threefold:—

1. To save running a new feeder.
2. To enable the station to be shut down at night.
3. To act as a balancing device.

The battery is fixed in five arches carrying the roadway at Hunt's Bank in front of the Cathedral. One arch is utilised as a switch room, the other four for containing the cells.

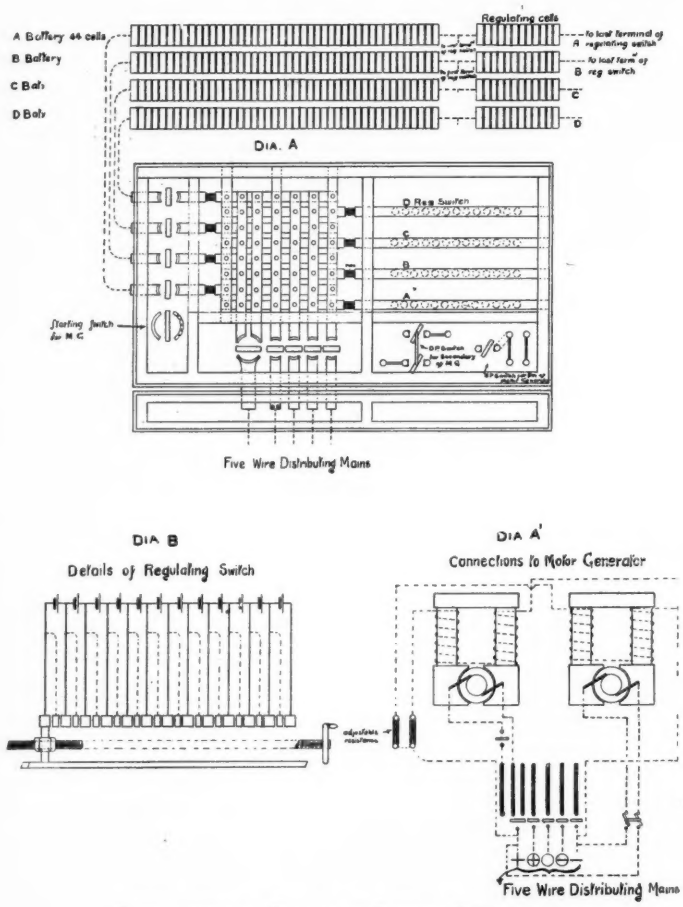
Two hundred and twenty-four chloride cells, each capable of giving a discharge of 600 amperes for $2\frac{1}{2}$ hours, are arranged here. They are divided into four distinct batteries, A, B, C, and D, composed of 56 cells each. Each battery is further divided into two portions, one containing 44 cells,

the other containing 12 regulating cells. In one of the arches two 44-cell batteries are placed one above the other, the upper being carried by wrought-iron girders on cast-iron stands, and the other two batteries are placed each in an arch to itself. The regulating cells belonging to all four batteries are placed together in a separate arch. A view of one of the batteries and regulating cells is given.

The five distributing mains are connected to five vertical bars on the switchboard, eight horizontal bars cross these, and at the points of intersection holes are drilled, those in the hinder bars being tapped with a screw thread. Screw plugs with flat collars inserted in the front bars, and screwing into the back bars, enable any vertical bar to be connected to any horizontal bar. One pole of each of the four main batteries is connected directly to a horizontal bar. The remaining four horizontal bars are prolonged, and by means of a sliding brush, each may be connected to any one of 13 contacts; these contacts are connected to the terminals of sistance, and then directly into the circuit. In this manner, the circuit is never opened, nor is a cell short-circuited.

The battery is charged from the ordinary distributing mains, the pressure being raised to the requisite extent by means of a motor generator. This motor generator consists of two separate machines, one a motor taking current from the outer distributors at a pressure of 400 volts, the other a dynamo generating current at a pressure from 0 to 180 volts. Adjustable resistances placed in circuit with the field magnets of both machines enable the speed of the combination to be varied.

The secondary terminals of the motor generator are connected to two additional vertical bars on the switchboard. One of the outer distributors may be connected by means of a two-way switch, either to a vertical bar on the switchboard for discharging, or to one of the two motor generator bars for charging (see diagram A). When on the latter, the pressure given by the motor generator is added to the pres-



Connections and Details of Battery Switchboard.

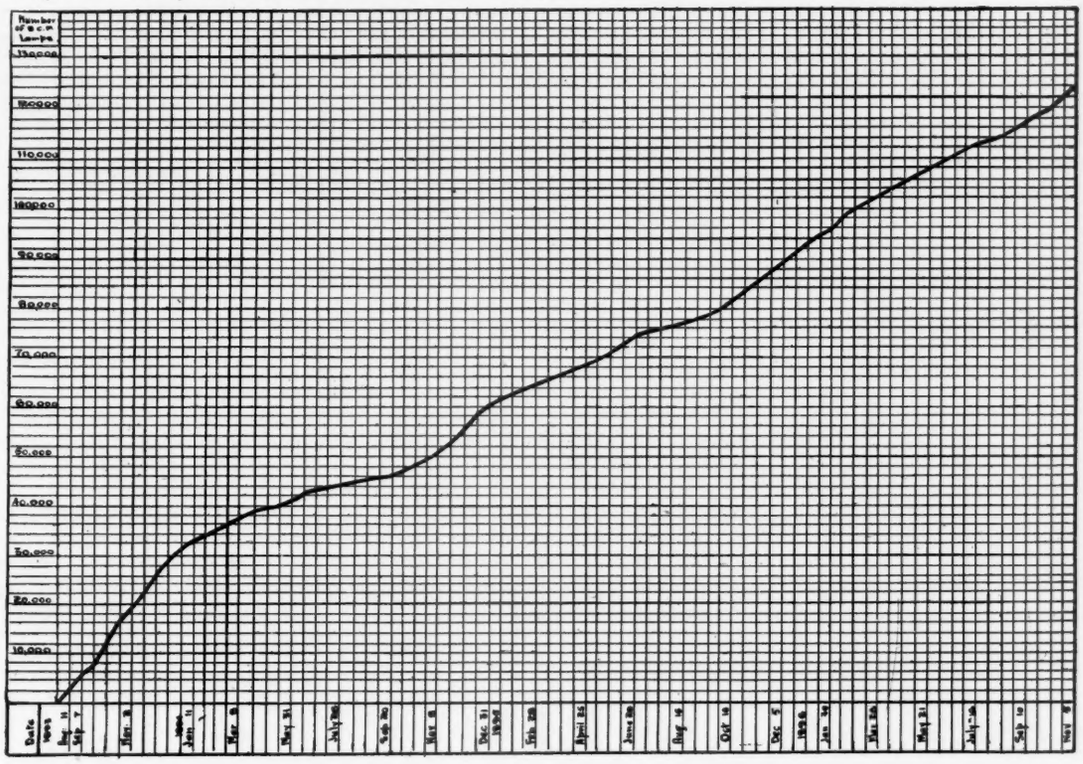
Plan showing Area Comprised Under Provisional Order, 1896. District Already Supplied Shown in Black.

the regulating cells of the respective batteries. The other pole of the main battery is connected to the first contact of this regulating switch; thus, when the sliding brush is at one end of the bar, the main battery is connected directly to its two horizontal bars, and all the regulating cells are cut out. When the brush is at the other end, the main battery is connected in series with all the regulating cells to the horizontal bars. The switchboard thus enables any of the four batteries, with its regulating cells, to be placed between any of the four pairs of mains formed by the conductors of the five-wire network. A photograph of the switchboard show its general appearance. Diagram A gives the connections above described, and diagram B gives details of one of the regulating switches. From this last diagram it will be seen that between each of the contacts is placed a smaller intermediate contact. This is connected through a resistance, consisting of a straight iron bar, to the next cell, and thus when the switch brush is moved from one cell to the next, it first connects the additional cell through a resure of the mains. The three intermediate distributors are disconnected from the switchboard during charging, and all cells are charged in series. Should one battery require more charging than the others, it is connected directly by means of plugs to the motor generator bars, and charged by itself.

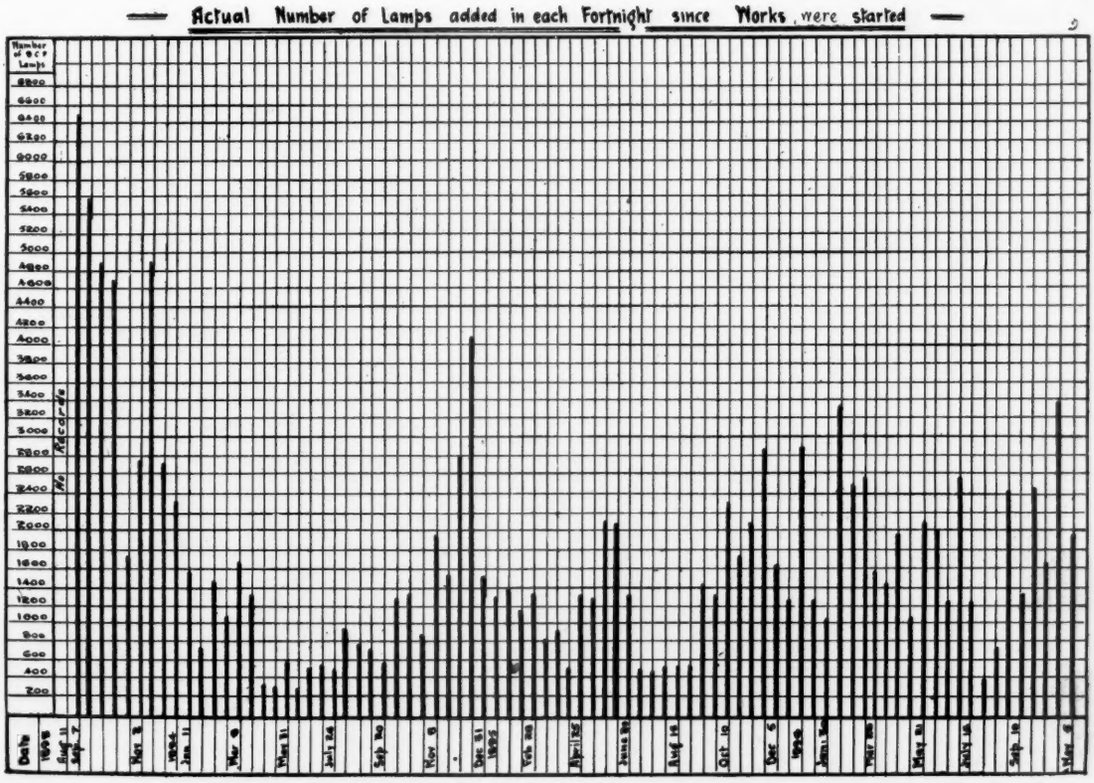
The switchboard was made by the Electric Construction Company, of Wolverhampton, to detailed designs by Mr. C. H. Wordingham. With the exception of ebonite bushes, it is wholly of metal and porcelain, and is, therefore, absolutely fireproof.

Mr. Wordingham's object in the design of the whole of this sub-station has been to render it impossible for anything to burn, and with this in view, in spite of considerable difficulties, he has worked out all the connections to the various cells in bare copper rods. The regulating cells are connected by means of solid copper rods $\frac{7}{8}$-inch diameter. These are jointed together with screw couplings, afterwards sweated, and are carried on porcelain insulators in cast-iron frames, which frames are themselves insulated from earth with oil

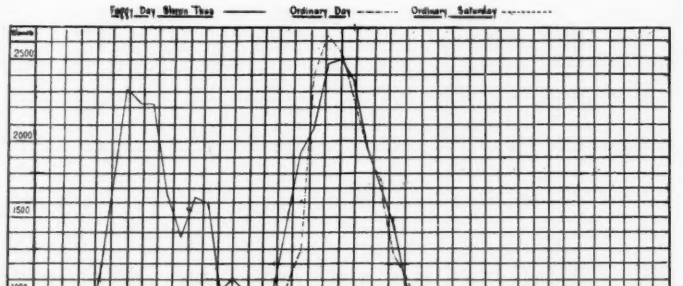
— Total Number of Lamps connected at end of each Fortnight since Works were started —



— Actual Number of Lamps added in each Fortnight since Works were started —



insulators. Where the conductors had to be taken through a wall, about a yard of flexible cable insulated with vulcanised India-rubber was fused on to the copper rod, the other end being sweated on to a similar rod. The covering of the cables is not relied upon for insulation, as the cables are further insulated by being taken through porcelain tubes carried on slate slabs placed edgewise, the whole being made air-tight by means of ozokerite wax. The connections to the main batteries are of bare copper rods, $1\frac{1}{8}$-inch diameter, carried overhead on oil insulators, supported by cast-iron girders. The rods are stiffened by being enclosed in wrought-iron gas barrel very slightly larger than the rod. In a few cases it was impossible to avoid the use of insulated cables for some of the cross connections of the batteries, and where this has been done, stranded cables insulated with vulcanised India-rubber are used, being completely enclosed in lead pipes, and buried as far as possible in the concrete of the floor. The measuring instruments are all carried on a cast-iron frame channelled at the back, the channels being arranged to carry the instrument wires. The instruments comprise four 150-volt Weston illuminated dial voltmeters, each provided with a two-way switch so that it may be put either on the battery or on the distributing mains. A similar voltmeter reading up to 600 volts is provided with a two-way switch, so that it may be placed either across the outer distributing mains or across the whole battery, and a voltmeter of the same pattern reading up to 200 volts is connected to the secondary of the motor generator. Four ammeters of the Weston illuminated dial pattern, arranged to read to 300 amperes in one direction, and 600 amperes in the opposite direction, are connected as a shunt to the bare copper rods. Each ammeter has a two-way switch, so that it may either read direct or to four times the actual current. Arrangements are made to blow air into the arches so as to keep them free from an accumulation of gases.



Manchester Load Curves.

There is very little doubt that the battery has proved a most valuable adjunct to the Manchester system, and on more than one occasion, since the battery was brought into operation at the end of last spring, has its value been demonstrated.

The whole night load of the central station, after midnight, is taken by the battery, and has enabled the third shift of hands, viz., 10.0 p.m. to 6.0 a.m., to be almost entirely dispensed with, while on Sundays relief is also given to the second shift, the battery taking the day load up to 4.0 p.m., in addition to the previous night load.

As we have already said, the cells are of the chloride type, and have been supplied and erected by the Chloride Electrical Storage Syndicate, Limited. Each cell contains 73 plates of their well known "R" type. The containing cells are of stout sheet lead, and are carried on iron and timber stands, and the battery is insulated throughout by means of duplex oil insulators. The plates are supported in the cells by means of glass side plates or hangers, and separated from each other by solid glass rods. The frame of each plate is cast with an extension lug, which is homogeneously burnt with the corresponding lug of opposite polarity of the next cell on to a continuous lead T section, which runs between each cell, supported on porcelain oil insulators.

One cannot help noticing the admirable way in which the extensions have been carried out, and how well the system works as a whole; both the engineer and the Corporation are to be congratulated, not only for the manner in which they have met the demand for electric energy, but for their persistent efforts to carry the supply throughout Manchester. A glance at the area of Manchester will show how much the Corporation have yet to do before they can reach a period of rest, but in dealing with greater Manchester we have no doubt that the work will be sound; it will, at any rate, be interesting.

Since July, 1894, when Dr. John Hopkinson's agreement with the Corporation ceased, Mr. Wordingham, in addition to his ordinary duties, has acted as consulting engineer to the Corporation, and has designed and personally supervised, the carrying out of all the extensions.

FREE LAMPS.

There can be little doubt that we are passing through a process of evolution in the public supply of electricity. Hitherto the subject has been considered mainly from a supplier's aspect; but there are now distinct signs that the matter is to be discussed from the consumer's point of view: the same object is, of course, still borne in mind—that of increasing the output. Altogether the various schemes suggested for the amelioration of the consumer betoken a healthy activity among electrical engineers, and it will be surprising if their efforts do not have marked effect on the development of public supply. The benefits of free wiring have been already discussed in these columns, and though we were somewhat inclined to think that penny-in-the-slot meters a little too previous, we could not deny that they might play an important part in the economy of distribution.

Mr. Alfred Gibbings's scheme of supplying free lamps to his consumers after a certain consumption of electricity, is more difficult to appreciate at the first glance than free wiring. The eminent Bradford engineer bases his idea on the fact that the normal life of a lamp is 1,000 hours. If, therefore, a 16 C.P. lamp consumes 1 unit in $16\frac{2}{3}$ hours, it will consume 60 units in 1,000. From these well-known conditions Mr. Gibbings has initiated a scheme for supplying lamps to consumers, and the main condition is as follows:—"Every consumer of electricity from the Corporation mains will be entitled on and after January 1st, 1897, to one 8 or 16-C.P. incandescent lamp, supplied free of charge by the Bradford Corporation for every 60 units of electricity consumed since July 1st, 1896, by the use of incandescent lamps only. If other and higher candle-power lamps are desired instead of 16 C.P., the number of lamps to which the consumer is entitled will be in the inverse ratio to such candle-power. Thus:—

60	units	entitles to	one 8 or 16-C.P. lamp.
120	"	"	two 8 or 16-C.P., or one 32-C.P.
240	"	"	four 8 or 16-C.P., or two 32-C.P.
480	"	"	eight 8 or 16-C.P., or four 32-C.P., or two 50-C.P.

(The balance of units consumed in excess, viz, 105 in this last instance, being held over until the following six months' supply, or made up by lamps of a lesser candle-power, as may be desired by the consumer.)

While recognising that the Bradford Corporation are anxious to do all they can for their consumers, they are at the same time not running their electricity works on philanthropic grounds, and to appreciate the motives one has to go a little deeper into the question. It cannot be gainsaid that if the whole supply of lamps were in the hands of the suppliers of electricity, the advantage to the consumer would be, or ought to be, that he could secure

a really good lamp at a fairly reasonable price. Moreover, the means at the disposal of a corporation would enable them to supply only those lamps that had passed some kind of test. To return, however, to Mr. Gibbings's primary condition. If a consumer has used electrical energy equivalent to 960 units during a half-year he becomes entitled to 16 lamps for renewals. But there may be difficulties in ascertaining which lamps ought to be renewed. Indeed, we can quite conceive that when a consumer becomes entitled to a fresh supply of lamps, some of his old ones may have burned a good many more than 1,000 hours, while others had been in use for comparatively few hours. That is, perhaps, not a very serious difficulty, and no doubt the consumer would renew the worst looking lamps, though it is quite possible that a large consumer might be entitled at the end of a given period to new lamps, though none of his old ones had been in use for more than a few hundred hours.

Mr. Gibbings has shown that on the number of units consumed last year they would have had to give away 7,818 lamps, equivalent to a cost of £586. That is to say, the profits of the Bradford Corporation Electricity Works would have been lessened by £586. Why should the Corporation do this? At the first blush, the movement savours of philanthropy, but a closer inspection reveals the fact that though they may lose £586 per annum by giving lamps away, they are probably amply recouped in another direction. It has been conclusively shown in the lamp tests of Mr. Preece and other investigators that although an incandescent lamp may after middle life consume more energy per candle, the total consumption of the lamp is in most cases greatly diminished, and a lamp which at one period of its existence was consuming 60 watts and giving 16 C.P., might drop down to 54 watts and give perhaps 12 to 13 candle-power. Experience has shown that consumers have very little appreciation of a gradual diminution in light. It seems to us, therefore, that in a higher consumption of electricity per lamp, the Bradford Corporation will cover their losses in providing free lamps. On the other hand, the consumer's bill for electric energy will be slightly increased; he will, however, pay nothing for lamps, and will always have a better light, even if lamps are occasionally wasted. Mr. Gibbings's scheme has much to recommend it from a supply point of view, and we shall not be surprised if other municipalities adopt similar systems; at the same time, the customer may be advised to consider whether it is the best possible arrangement for him. The subject is, of course, a very important one, and we should like to have the views of some of our readers, both from a supply and consumer's point of view.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page 732.*)

Electrical Engineering in Germany.—Some experiments have lately been carried out at the works of the Hörde Union, at Hörde, Germany, in utilising furnace gases for the operation of gas engines, and the results have been so successful that it is stated that the company has placed an order for two large gas engines to be operated by furnace gases, the engines being intended to drive dynamos in connection with an electric power transmission plant. The Hörde Union has just placed a contract with Messrs. Schuckert and Co., of Nuremburg, for the supply of the necessary electrical plant.

Parliamentary Powers.—The following applications for electric tramway powers were notified in the *London Gazette* for November 27th:—

Bolton.—Powers to the Corporation to extend tramways, also to use electricity or other motive power.

Bristol.—Powers to the Bristol Tramways and Carriage Company, Limited, to construct new tramways in and about Bristol, also to use electrical power thereon, and on the existing lines.

Cardiff.—Powers to the Cardiff Tramways Company, Limited, to construct additional street tramways in the parishes of St. Mary, St. John, Roath and Canton, in the Borough of Cardiff; powers to use on these and also existing lines, electrical power either by the overhead system or otherwise.

Carlisle.—Powers to form a company to construct street tramways in and near Carlisle (3 feet 6 inches gauge), to work by means of animal or electrical power; also to enter into agreements with companies for the purchase of electrical power.

Coventry.—Powers to the New General Traction Company to construct tramways and work them by electricity or other motive power.

Great Yarmouth.—Powers to construct tramways in the Borough of Great Yarmouth, and in the parish of Caister, next Yarmouth; provisions to use electric, mechanical, or animal traction.

Norwich.—Powers to the New General Traction Company, Limited (of 35, Parliament Street, London), for constructing tramways in Norwich, to be worked by electricity or other motive power.

Penarth.—Powers to form a company for constructing, maintaining, and propelling by means of electrical, steam, or other mechanical power, street tramways between Cardiff and Penarth.

Salford.—Powers to the Corporation to construct tramways in the Borough to be worked by animal, steam, gas, oil, electricity, or other power.

Swansea Corporation.—Powers to purchase tramways, make extensions, to use electricity, to enter into agreements with the company for supplying electricity thereto, &c., &c.

Weston-Super-Mare.—Powers to incorporate a company to construct tramways, generating stations, &c., &c.; to employ animal or electrical power.

Rathmines.—The ratepayers of Rathmines and Rathgar Township have declared themselves at a public meeting opposed to the Bill proposed by the Commissioners for the construction of tramways between Rathmines and Ballsbridge, to purchase the tramways situated in the township, &c. A poll is to be taken.

The Crystal Palace Motor Car Awards.—The *Engineer* recently notified that the following awards had been made in connection with the recent exhibition of motor carriages at the Crystal Palace:—

Diploma for Gold Medal.—C. C. Burrell & Sons, for light compound traction engine; Emile Delahaye, for benzoline carriage; Mons. Serpollet, for steam carriage; the Steam Carriage and Wagon Company, for steam van.

Diploma for Silver Medal.—Société Franco-Belge, for steam brake; L'Hollier, Gascoine & Co., for benzoline carriages.

Diploma for Bronze Medal.—Arnold's Motor Carriage Company, for benzoline carriage.

From the report of the jurors, which is signed by W. Worby Beaumont, M.I.C.E., Walter Hancock, M.I.E.E., H. A. O. Mackenzie, C.E., and Alf. R. Sennett, A.M.I.C.E., Hon. Executive Commissioner, we make the following extracts:—"Although none of the vehicles exhibited approached that degree of perfection which would place them beyond the adverse criticism which condemns any evidence of an unrealised attempt, they are of opinion that several of the vehicles shown and worked in the Crystal Palace Grounds have reached a degree of practical sufficiency meriting some distinctive mark of appreciation. Most of the vehicles, which have withstood the test of considerably hard daily work, were propelled by motors actuated by the internal combustion of light oils, such as benzoline. Most of the carriages exhibited and worked in the grounds have motors supplied with hydrocarbon vapour, produced by the passage of air through some form of carburetter containing benzoline. This vapour, mixed with air, and compressed and heated by the incoming stroke of the motor piston, was, with one exception, ignited by an electric spark, obtained by means of a secondary battery and induction coil. The one exception was the carriage of Peugeot, fitted with a Daimler motor, and lent by Sir David Salomons. This vehicle, however, did not come within our cognisance at the time of our visit with respect to the merits and awards. The jurors considered it matter for regret that no electrically-propelled vehicle had been submitted for trial."

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1895 ...	...
Puerto Plata-Martinique ...	Dec. 19th, 1895 ...	...
Amazon Company's cable Parintins-Itacatiara	May 5th, 1896 ...	...
Pará-Maranham	Oct. 8th, 1896 ...	...
Chio-Tenedos	Nov. 24th, 1896 ...	Nov. 28th, 1896.
St. Lucia-St. Vincent ...	Nov. 30th, 1896 ...	...
St. Croix-Trinidad	Nov. 30th, 1896 ...	...

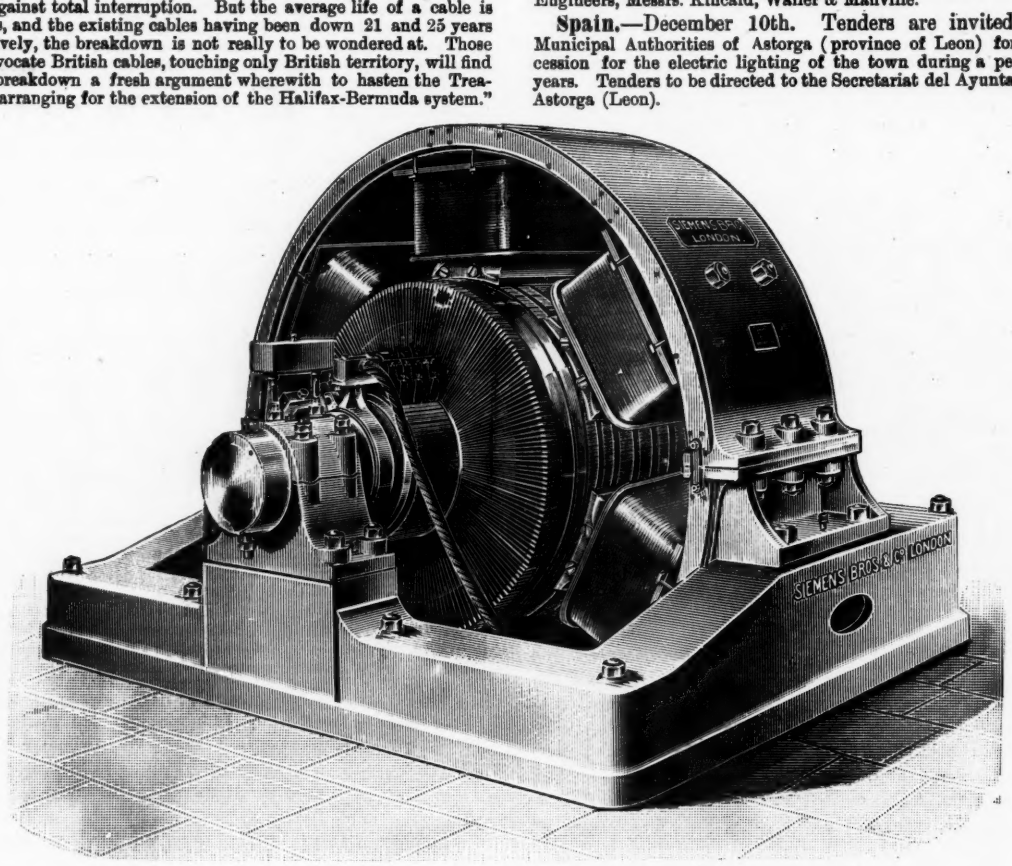
November 30th, 1896.—Delay of 12 hours on telegrams for St. Vincent, Barbados, Grenada, Trinidad, and Demerara, which are sent by boat.

Landlines.			
Trans-Continental line beyond Masol	March 12th, 1896 ...	...
Carthagena - Barranquilla (Columbia)	July 4th, 1896 ...	...

Coast Communication.—The Board of Trade report on the loss of the Dungarvon schooner *Carmel*, with her crew of five hands, in Liverpool Bay on the night of October 10th, says that "there is cable communication from the Formby light-ship to the lifeboat house, by means of which telephone messages can be sent, but on the evening in question the cable was broken. Signal rockets were, however, sent up from the two light-ships, and were observed at three lifeboat stations round Liverpool Bay." The report expresses the view that additional cable communication between the light-ships and the mainland is desirable.

A Cable to Iceland.—The scheme announced some time ago for laying a telegraph cable to Iceland, is not taking shape very rapidly. We now learn that Mr. John M. Mitchell, of Glasgow, "is promoting a scheme to establish telegraphic communication between Great Britain and Iceland." It is expected that the cable will cost about £100,000.

Telegraph Communication to the West Indies.—The following paragraph from Tuesday's *Daily Mail* is worth reading:—"It was officially announced in London yesterday that the St. Lucia-St. Vincent and Santa Cruz-Trinidad cables are interrupted, thus cutting off communication with St. Vincent, Barbados, Grenada, Trinidad, and Demerara. Telegrams for these places are despatched by boat, causing a delay of about 12 hours. This incident is interestingly instructive, occurring at a time when the Treasury are considering the question of extending the Halifax-Bermuda cable to the West Indies, an extension which Mr. Chamberlain has promised. It has been contended hitherto that the existing cable arrangements are sufficient, the double cable system being considered an ample safeguard against total interruption. But the average life of a cable is 20 years, and the existing cables having been down 21 and 25 years respectively, the breakdown is not really to be wondered at. Those who advocate British cables, touching only British territory, will find in this breakdown a fresh argument wherewith to hasten the Treasury in arranging for the extension of the Halifax-Bermuda system."



Bradford Electricity Works.

The New York *Herald* of November 14th contained a report of an application made to the Courts in the States regarding a proposal to lay a cable, and we extract the following therefrom:—An interesting case came up before Judge Lacombe, in the United States Circuit Court yesterday afternoon, when arguments were heard on the application made on the part of the United States for the granting of an injunction preventing the United States and Hayti Telegraph and Cable Company, and La Compagnie Française des Cables Telegraphiques, which now operates a cable line in Hayti and elsewhere throughout the West Indies, from completing the cable now being laid between the Coney Island shore and Hayti. It is ostensibly asked for by the United States, although it is said that the Western Union Telegraph Company is the real objector in the case, and that the United States and Hayti Telegraph Company and the French Cable Company are working for a common purpose, which is to give the French company an entrance into the United States for their cable line from Hayti. After hearing counsels' arguments, Judge Lacombe remarked that if it was found that the cable was an intrusion upon the United States territory, the executive had the right to tear it up and throw it back into the sea. The subject, he thought, was something with which his Court could not very well interfere. He took the papers under advisement, however, and will render his decision later.

CONTRACTS OPEN AND CLOSED.

OPEN.

Brussels.—December 11th. Tenders are being invited for the supply of pipes and other material required during 1897 in connection with the municipal electric lighting undertaking. Tenders to be directed to the Hotel de Ville, Brussels.

Denton.—Messrs. John Lever & Co. of Denton, Lancs., are inviting tenders and specifications for an electric lighting installation.

France.—December 8th. Tenders are being invited by the French Post and Telegraph authorities in Paris for the supply of seven lots of telephone cables. Tenders to be directed to the Sous-Secretariat d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris.

Islington.—December 16th. The Vestry invites tenders for the supply of certain machine, smith's and engineer's tools. See our "Official Notices."

Southampton.—December 4th. Tenders are invited by the Corporation for the supply and laying of insulated electric mains, conduits, and drawing-in boxes. Further particulars from Messrs. Kincaid, Waller & Manville.

Southampton.—December 4th. The Corporation invites tenders for the erection of buildings for an electric generating station. Engineers, Messrs. Kincaid, Waller & Manville.

Spain.—December 10th. Tenders are invited by the Municipal Authorities of Astorga (province of Leon) for the concession for the electric lighting of the town during a period of 20 years. Tenders to be directed to the Secretariat del Ayuntamiento de Astorga (Leon).

Spain.—December 16th. The General Direction of the Spanish Posts and Telegraphs in Madrid is inviting tenders for the supply of 20 tons of bronze telegraph wire. Tenders to be sent to the Direccion Général de Correos y Telegrafos, Calle de Carretas, 10, Madrid.

Wakefield.—December 14th. Tenders are invited by the West Riding County Council for the maintenance and renewal of the electrical recording stations, signals, bells, and telephones at the Wakefield Asylum. Particulars from Mr. J. S. Banks, Clerk of Works, The Asylum.

CLOSED.

Southampton.—The tenders sent in for fitting up the Municipal Offices and Guildhall for the electric lighting are as follows. Municipal Offices, £239, Guildhall and Police Offices, £131, Messrs. E. T. Fiford & Sons; £225—£105, Messrs. A. Ford Lloyd & Co.; £231—£122, Mr. Frank Shalders; £212—£119, Messrs. Sanby & Co. The protecting tender of the electrical engineer (Mr. J. H. Lee) for the Municipal Offices, Guildhall, and Police Offices was £554. The committee recommended the acceptance of Messrs. A. Ford Lloyd and Co.'s tender for the Guildhall and Police Station at £105, and Messrs. Sanby & Co.'s tender for the Municipal Offices at £212. One informal tender was received in addition to the above. The Council adopted the Committee's recommendation.

Russia.—The contract for the supply of a complete electric lighting plant for the Imperal Palace at Zarskoie-Selo near St. Petersburg, has been placed with Messrs. Brown, Boveri & Co. of Baden, Switzerland.

BRADFORD ELECTRICITY WORKS.

Messrs. Siemens Bros. & Co. have lately supplied two 500-kilowatt continuous current dynamos to the Bradford Electricity Works, and as, in this instance, they have departed from their usual construction, inasmuch as the machines are multipolar, a short description may be of interest.

The two dynamos are exactly similar, and one of them is shown in the accompanying illustration. They are coupled directly to Willans engines, the output of each set being 750 amperes at 500 volts, and the speed 300 revolutions per minute.

The armature is a Siemens drum with stranded bar conductors; in this instance the diameter is nearly twice the length of the pole-pieces. The commutator has 211 segments, and there are two sets of brushes placed at 60° angular distance apart, each set consisting of three brushes. The armature resistance from brush to brush is less than one hundredth of an ohm; the weight of the complete armature is 6½ tons.

There are six field magnets arranged equidistant inside a heavy forged iron ring, which forms the common yoke, and 8 feet in diameter over all. The pole pieces are rather more than 2 feet across, and the wire is wound on a wooden frame. All six magnet coils are connected in series, and have a total resistance of 41 ohms; they are connected in shunt to the armature with an intercalated switch and resistance. The whole ring of magnets weighs 11 tons, bringing up the weight of the whole dynamo, inclusive of bed-plate, to rather over 21 tons.

Advantage was taken of there being two similar machines, to test them by the Hopkinson method, when the following efficiencies were measured :—

At ¼ load	... ...	90½ per cent.
At ½ load	... ...	94¼ „
At full load	... ...	95½ „

NOTES.

Electricity Applied to Agriculture.—The German Agricultural Society has arranged a prize competition among power-driven ploughs, intended more especially to encourage and develop the application of electrical power to the working of ploughs and other agricultural implements. The Society considers that, for many reasons, the application of electricity to agricultural driving promises considerable success, especially on account of the facility which electricity offers for transmitting power to considerable distances. In the trials which will be made by the Society, non-electrical ploughs will also be tested, so that a comparison may be made of the relative efficiency of the different systems. The tests will be made with ploughs only, since it is considered that only small alterations will be required to apply the power to other implements. Special attention will be attached to the conveyance of the arrangements from field to field. A first prize of 3,000 marks, and a second prize of 1,000 marks will be given for the best plough driven by any kind of power, and a special prize for the best electrically driven plough. At the trial, a piece of heavy and a piece of light land will be assigned to each plough, and the following points will be noted:—1. The time taken for the ploughing. 2. The weight of earth moved. 3. The consumption of fuel by the motor. 4. The power consumed between the motor and the plough. 5. The cost of the ploughing, including fuel, water, lubricants, attendance, repairs, interest and depreciation. Full information about this interesting competition will be found in the *Electrotechnische Zeitschrift*, November 12th, 1896, p. 712.

Lectures.—Before the Manchester District Institution of Gas Engineers meeting, held at Bradford on Saturday last, when Mr. G. E. Stevenson, of Manchester, read a paper entitled, "Some Notes on the comparative Cost of supplying Light by Gas and Electricity in Manchester."

"Horseless Carriages" was the subject of a lecture delivered by Mr. Geo. Johnston before the University Engineering Society at Glasgow on 26th ult.

Jacobi, 1834, v. McDonald, 1896.—Everybody who has put money into that McDonald battery scheme would do well to read, learn and inwardly digest the following, which we quote from the first instalment of a series of papers on electrical engineering from the pen of Mr. Edward A. O'Keefe, in Part I. of the cheap edition of "Cassell's Technical Educator," which is just issued. Mr. O'Keefe discusses the reason why Jacobi's electrically propelled boat was a commercial failure, and this has a very significant bearing on the forthcoming trials, if they are ever made, of the *Medusa*. "The current," says Mr. O'Keefe, "was supplied by the consumption of zinc in the voltaic cell; in other words, zinc was the fuel which was consumed or burnt up in the cell in order to supply the current to the motor. Let us compare it with the fuel which is consumed in order to supply steam to the steam engine. A pound of coal is capable of doing about four times as much work, when burnt, as a pound of zinc, and zinc is about 50 times as dear as coal; therefore, for the same amount of money, we can get about 200 times as much work from coal as from zinc. This is on the supposition that both methods of working are equally efficient; but it is found in practice that the electrical method of consuming the fuel has an advantage of about four to one, which leaves a final advantage of about 50 to 1 *in favour of coal* in the steam engine against zinc in the cell." Zinc at 3d. per lb. is practically 50 times as dear as coal at 12s. per ton, a price at which steam coal can be readily obtained in many of our large manufacturing centres. The invention of the dynamo as a cheap means of producing electrical energy has rendered possible what Jacobi could never effect; yet the McDonald's and their financial supporters would take us back again to the days of 1834! In common fairness, we ask that the editors of these Scotch newspapers, in which the McDonald cell was boomed for all it was worth (!) should place these elementary facts before their readers, many of whom seem to have been temporarily bereft of that canniness with which it is customary to credit our neighbours over the border. And before a state of mental balance is restored, many a "bawbee" will have gone the way of most things.

Tests of Primary Batteries.—With reference to our recent article on the McDonald battery, it cannot be too strongly asserted that a vital element in the power of a double fluid cell is the degree of hardness of the porous pot that separates the two liquids. To test one cell with a hard pot against another with a soft pot is to make a test which gives no correct indication whatever of the general value of the combinations which constitute the real difference between the two cells. The cell with the hard pot will of course work at a disadvantage; it may give a small output not because it is chemically a bad combination, but simply because it has a defective portion in it, a defect of manufacture and not of design. Unless, therefore, the particular hardness of the porous pot is an essential element to the efficiency or constancy of the cell, it should not be made greater in one battery than in another, if the tests are to be of any relative value. Again, with reference to the McDonald cell, the idea of using broken carbon to obtain, we presume, a large surface, is a delusion. The only case in which a large surface is of value is when the nature of the chemical action is such as to cause polarisation at the negative electrode; in this case, the less the current density the less the rate of polarisation, and by making the electrode surface large, the current density becomes proportionately diminished. When, however, a cell is to all intents and purposes a Daniell, polarisation does not take place to any practical extent, and nothing is gained by having a large exposed surface. The idea that the latter diminishes resistance is another delusion, as in any cell formed of two concentric surfaces exposed to each other, resistance is a function of the distance between the surfaces, of the diameter of the inner (usually the positive) electrode, and of the length of the concentric surfaces; it is *not* a function of area exposed in any other sense.

Search Lights.—Some experiments took place at Plymouth, on Tuesday evening, to test the efficiency of a new system of electric search lights, which, according to the *Standard*, have been fixed at various points guarding the entrance to the port and dockyard.

To Electrical Contractors.—Electrical men should read, mark, learn and inwardly digest the following letter which has appeared in the daily press from the pen of "W. R. H.":

The following fact may act as a warning to those who look at foreign progress in commerce as due to causes beyond the control of British brains.

In a large Continental city tenders were lately invited for an electric light plant. Agents, both English and foreign, tendered personally, and a German firm obtained the contract. One English house tendered, through its agent, with weights and measures calculated in pounds and yards, and when the agent was requested to turn his figures into decimal weights and measures, he could not do so, and his tender could not even be considered.

How long is British trade to be thus handicapped, not by the want of compulsory metric legislation, but by crass obstinacy (the word ignorance is out of the question in these days of Board schools, of course), which will not adapt itself to the requirements of the world's trade.

Another matter which should be well considered by electrical contractors and financiers in this country is the following extract from the *Financial News*:—

American Capital in China.

American newspapers express the opinion that American capital will take a prominent part in the development of China. They state that an American syndicate has submitted bids for the building of a railroad from Soochow to Chinkiang, and for the building of an electric tramway in the foreign concessions at Shanghai. Mr. A. W. Bass, of Port Townsend, Washington, is the representative at Peking of a combination of capitalists in New York who wish to secure railroad, mining, and other contracts in China. This syndicate has organised a company called the American China Development Company, incorporated under the laws of the State of New Jersey.

A few reliable business men with a knowledge of Eastern languages, and well up in foreign weights and measures, if sent out by British electrical contracting houses, might turn many valuable contracts into a British channel, and so make such a trip well worth while.

Another New Use for the Electric Furnace.—An interesting process is now being conducted at Charlottenburg, in Germany, by H. Mehner, by means of which ammonia and nitrides are produced. The essential features of the process are as follows:—Oxygen compounds of such elements as boron, silicon, magnesium, titanium, and vanadium, capable of combining with nitrogen at a high temperature, are exposed to the heat of an electric furnace in the presence of free nitrogen and carbon. A high-tension current must be employed, unless the furnace be fed with coarse pieces of coke, and a jet of sand be blown in whilst generator gas is introduced; on entering the hot zone of the electric furnace, the sand is said to evaporate, and then acts as desired. Nitrides thus manufactured may be treated with steam to obtain ammonia, and an oxide from which a nitride may be re-formed as before.

A New Invasion.—The Montreal *Daily Star* says that an immense international street railway syndicate has been formed in Cleveland to work European railways by compressed air. The syndicate does not appear to be afflicted with modesty, for it is stated that already there are 20 European cities whose railways will be operated by the group of capitalists in the project. Amongst them are London—both surface and underground lines—Birmingham, already being operated by the syndicate, Sheffield, Edinburgh, Dublin, Paris, Marseilles, Berlin, Hamburg, Vienna, and, perhaps, the Eternal City. There is associated with this scheme Mr. James Ross, who is putting the Birmingham trams in order. If, however, this Yankee syndicate has nothing more to offer than compressed air, then all we can say is, there is not much room here.

The Kent Coal Fields.—We understand from a Dover contemporary that the Kent Coal Field works are to be connected with the telephone system. The works are now lighted electrically, the electric light being used in the pit during the sinking operations. It has also been decided for the safety and convenience of the workpeople to carry the light up the staircase on the face of the cliff, which is practically the only approach to the works. This is an excellent opportunity for utilising electric power in mining work. The advantages of electric power transmission have doubtless been brought before the company by the electric lighting contractor.

Begun at the Wrong End.—All those who know and appreciate him will welcome—as the return of a prodigal son—the reappearance of Mr. J. S. Raworth in serious solid masterpieces of literary work, filled with sound engineering skill, instead of in smartly written semi-personal letters to the electrical "society journals." His paper on "Cheap Steam Power," read the other day before the Northern Society of Electrical Engineers, will take high rank not only for the charming way in which his own efforts obtained self-commendation, but also for the many new ideas and currents of thought therein suggested to the intelligent reader. Not the least of these latter is that contained in the paragraph of his paper recommending the dayload plant of an electric station to have maximum efficiency almost regardless of prime cost, whilst for the full load plant anything will do that is cheapest to buy, not necessarily the most efficient. Obviously, electrical engineers are still possessed with the idea that lighting is the chief end and aim of their existence, seeing that electric stations are all designed primarily for this purpose. Such a feeling is quite natural, and also out of date. An unprejudiced mind in newly attacking the subject, would say at once that, instead of planning a station for a full load of two hours in the day, the lighting should take second place altogether: the tramways in the town (and where there is room for lighting there is, or ought to be, room for a tramway) must have the first consideration, and the station be so designed as to obtain full load on this work for 18 hours a day instead of 2. Then the lighting curve peak is met by reserve plant or storage cells. At present, the general idea in combined working appears to be that the tramways are to have the reserve plant for their operation—coming in, as it were, like an afterthought. This is an inversion: and the so-called dayload plant (which, being comparatively small, may still remain as economical and efficient as possible) will in future serve for the excess lighting load coming on between about 5 and 9 p.m. As the full load plant thus runs for nearly twice as many hours in the day as Mr. Raworth's suppositional cotton mill engine, the relative proportion per I.H.P. hour between capital charges and cost of fuel becomes such as to make it more worth while than ever to instal economical engines, if not cheap ones; so that from every point of view we may look in the future on electric tramways as the great improver of central station load factors, and the reducer of works' cost per unit.

Note on the Conductivity of Ferric Chloride.—H. M. Goodwin, of the Massachusetts Institute of Technology, read a paper at a recent meeting of the American Academy of Science on the hydrolysis of ferric chloride. In this paper he calculates the degree of hydrolysis of ferric chloride from determinations of the conductivity and freezing point. He found it to be inappreciable in fairly concentrated solutions, for example, decinormal solutions, but nearly complete in more dilute ones, such as millinormal solutions. He also describes and discusses the remarkable increase in conductivity with the time which such solutions manifest.

The Northern Society of Electrical Engineers.—At the meeting to be held at Manchester on Monday, December 7th, a paper on "The Manufacture of Alkali and Bleach by Chemical and Electrolytic Methods" will be read by Mr. Bertram Blount, of London.

Royal Society.—Sir Joseph Lister, in his presidential address delivered before the anniversary meeting of this Society on 30th ult., referred among other subjects to the Röntgen rays, helium, &c. The following medals were presented:—The Rumford Medal to Prof. Philipp Lenard, and also to Prof. Wilhelm Conrad Röntgen (received by Count H. Hatzfeldt), for their investigation of the phenomena produced outside a highly exhausted vacuum tube through which electrical discharge is taking place; the Davy Medal to Prof. Henri Moissan (Paris), for the isolation of fluorine and the use of the electric furnace in the preparation of refractory metals. The anniversary dinner of the Society followed.

Railway Carriage Lighting.—The American correspondent of the *Engineer* says that on the Pennsylvania Railroad there is now running a car lighted by a combination of dynamo—driven from one axle—and storage batteries, on the Moskowitz system. A pulley on the axle drives by belting a countershaft, from which another belt runs to the pulley of the dynamo mounted on the bogie truck. The dynamo is self-regulating for the varying rates of speed of the train, and it is claimed that at a train speed of 60 miles per hour the voltage of the dynamo is only 3 volts higher than at a speed of eight miles per hour, this result being secured by a patented method of dynamo winding. The dynamo does not generate any current as long as the speed of the train is below eight miles per hour. To provide for the movement of the car in opposite directions, it is necessary that the dynamo should generate the current in either direction, and to effect this the electric poles are automatically changed in accordance with the direction in which the car is moving, so that the dynamo generates current at all times when the speed exceeds eight miles per hour, no matter in which direction the car is moving. This pole-changing device is one of the special features of the Moskowitz system. All the time the train is running, and also when the train is at rest or moving at slow speed, as in stopping or starting at stations, the current for the lights is supplied by storage batteries of a special type, which are carried in two wooden boxes under the car, and while one set is furnishing light, the other is disconnected, and is being charged from the dynamo. If the batteries are first charged sufficiently to furnish light for six hours, the plant will furnish light for from 10 to 15 hours every night, as long as the car is kept running. When put on the side track the batteries are shut off, and the stored batteries are ready to furnish light at a moment's notice. Owing to the use of the batteries the light is maintained quite steadily, there being at no time a direct current from the dynamo to the lamps. The car has 12 lights in the body, fixed at the lower edge of the clearstory or mansard roof, and one over each end platform, also one in the closet where the switchboard is fitted, or 15 in all. No special attendant is required, the brakeman or car porter having merely to turn the lights on or off at the switchboard. The lamps are of 32-candle-power, with short start filaments and short bulbs. The batteries have 32 cells, and weigh 1,440 lbs. in all. The dynamo weighs 300 lbs.

The South Eastern Railway Company has introduced into the London and Hastings service a vestibule train of American cars, each of which is fitted up to generate its own current for electric lighting.

Foreign Appointments Vacant.—Unmarried electrical engineers who have a desire for forsaking the mother country in favour of the West Coast of Africa, will find two announcements of interest in our "Official Notices" this week. The Crown Agent for the Colonies wants an electrical engineer at £50 per month, and an assistant electrical engineer at £300 per annum, for erecting and working electric lighting plant at Lagos. The terms of engagement will be found in the announcement. An engine driver and fitter at £250 per annum is also required for the same place. Applications have to be lodged by December 14th.

The Action against the Dublin Corporation.—The case brought by Messrs. Oetzmann & Co. against the Corporation of Dublin, for failure to supply their premises with electric current, was settled on 30th ult. We referred last week to the facts. Mr. Byrne, the magistrate at the Southern Police Court, dismissed the summons without costs. His reason for doing this was that he found that the plaintiffs had not complied with the requisites of the provisional order, inasmuch as they had failed to serve the Corporation with notice of their requirements in sufficient detail.

The B.A. at Liverpool.—The receipts of the recent meeting of the British Association at Liverpool amounted to £3,599, and after paying all expenses, a balance remains of £980, which will be applied to the publication of scientific proceedings and the prosecution of scientific research. It is stated that the amount (£1,355) available for grants to committees for the advancement of science is greater than has been known for a number of years.

A Danger in the Streets?—We should not like to hurt the feelings of the Rev. P. Clementi Smith, of the Rectory, St. Andrew's Hill, but we could wish that he knew a little more of practical electrical matters. He has written to the *Times* in the following strain:—"We have narrowly escaped a very serious explosion at one of the largest electric transformer stations in the City, near the north entrance to St. Andrew's-by-the-Wardrobe, and immediately opposite my rectory. About midday, so imminent was the danger, that the police had to practically close the street to all desirous of passing up or down, and I having gone for a short walk after morning service, was for a time unable to re-enter my house. The danger was caused by the hydraulic main bursting and flooding the electric transformer. Another foot of water and there would have been a fearful explosion. Not long ago there was an explosion near here on Ludgate Hill, and there have been, and, I fear, are likely to be, similar explosions. Surely it is a fearful risk allowing these transformer stations to be in public thoroughfares." If the police had only arrested the flow of water for causing an obstruction, they would have saved the reverend gentleman a good deal of worry.

A New Accumulator.—Every now and then we see in the *Chemical News* a communication from a Mr. Henry N. Warren, who usually describes himself as a research analyst. There are very few fields of research which this gentleman does not, at some time or other, venture into, and we fancy we have had occasion to notice his work before. This versatile gentleman has recently been turning his attention to a non-sulphating phospho-accumulator, and he describes what he has been doing in the *Chemical News*, 1896, lxxiii., p. 191. It seems that lead grids of special construction are repeatedly pasted with a composition of litharge and phosphoric and sulphuric acids, and dried for hours at 250° F., until biscuit plates are obtained; these are piled with alternate plates of amalgamated zinc and insulating carbon blocks in dilute sulphuric acid, with or without 12 per cent. of phosphoric acid, until perfectly reduced; they are then washed and peroxidised, being subsequently soaked in a dilute phosphoric acid.

Note on Argon and Helium.—In the *Zeitschrift für Physikalische Chemie*, Vol. xix., p. 657, Siegfried Friedlander gives an account of some experiments and observations of argon and helium. He concludes that although argon was found incapable of reaction in the numerous attempts of its discoverers, of Berthelot, and of H. Moissan, yet it reacts with platinum, as Troost and Ouvrard had already shown for magnesium, on the prolonged action of electrical discharges. As regards helium, he found that it also reacts with platinum on the prolonged action of electric discharges. With aluminium, Bohuslav Brauner has inferred an absorption of helium. The remaining part of the paper is an analysis of the theories respecting these two substances, and the author evidently believes that Lord Rayleigh and Prof. Ramsay have really revealed two new elements.

The Daily Press and Refuse Destruction.—The daily press has, within the past few days, been devoting attention to the Hackney Vestry refuse destructor scheme. To read these notices one might think such a proposal had never before been heard of, and that the consulting electrical engineer of Hackney was the originator of the idea of utilising refuse in connection with electric lighting. This scheme was particularised in the technical and local press a long time ago, and we believe we are correct in saying that the Hackney Vestry is not very enthusiastic over the proposal, having postponed it until the Shoreditch undertaking has been at work sufficiently long to judge from its results the likelihood of success at Hackney.

Physico-Chemical Studies of Water Solutions.—At a recent meeting of the American Academy of Science, H. C. Jones, of the John Hopkins University, read a paper on the "Physico-Chemical Study of Water Solutions of some of the Alums." By electrical conductivity measurements, he showed that in rather concentrated solutions there is present some of the undissociated double salt, whereas in very dilute solutions, complete dissociation takes place.

Brighton Seashore Railway.—This railway which we described and illustrated last week, was opened last Saturday in a befitting manner.

Interesting.—In looking over our small advertisements probably it may have been noticed that the number of "situations vacant" is now greater than those "wanted." This may be to some extent an exceptional occurrence, but it is the reverse of what used to be the case; let us hope that it is "a sign of the times," and will henceforth be the rule rather than the exception. "The old order changeth, giving place to the new," and the electrical engineer reaps the advantage.

Charge of Fraud.—At the Thames Police Court last Saturday, a number of charges of obtaining money by false pretences, were brought against Samuel Finn, electrical engineer, of 670, Commercial Road. Evidence was called to show that Finn had advertised for apprentices to learn electrical engineering, but after receiving premiums taught them nothing, but put them to the most menial occupations. The case was adjourned.

Liverpool Overhead Railway.—A railway contemporary states that the southern extension of this line connecting the north suburbs of Seaforth and Waterloo, with those of Prince's and Sefton Parks, is to be opened for public traffic on the 21st inst.

Electric Clocks.—Electrically controlled clocks are in use at Glasgow, as already stated, and a proposal is now before the Dundee Harbour Trust to similarly control the clocks at the Dundee Docks.

Appointment Vacant.—The Derby Corporation want an assistant electrical engineer. For details see our "Official Notices."

NEW COMPANIES REGISTERED.

The Dundalk Electric Tramways Company, Limited (2,609).—This company was registered in Dublin on the 23rd inst., with a capital of £1,000 in £1 shares, to promote and obtain the necessary authority under the provisions of the Tramways Act authorising the construction, maintenance, and working of tramways in the town of Dundalk, and the County Louth, or in such other places in Ireland as the company may from time to time determine upon. The subscribers (with one share each) are:—W. R. Nolan, Brookville, Donnybrook, publisher; F. W. Crossley, 24, Nassau Street, Dublin, publisher; R. M. Sanders, Sanders Park, Charleville, County Cork, J.P.; Mayo Palmerstown, Straffrn, peer; D. J. Wilson, Glenard N.C. Road, Dublin; Michael Nugent, Essex Street, Dublin, merchant; W. C. Dickenson, 1, Waterloo Road, Dublin, Colonel. Until the election of directors the affairs of the company shall be managed by the subscribers in the memorandum and articles of association. Registered by V. B. Dillon, 7, Rutland Square, Dublin. Registered office, 32, Molesworth Street, Dublin.

Bray Electric Tramway Company, Limited (2,610).—This company was registered in Dublin on the 25th inst., with a capital of £1,000 in £1 shares, to promote, construct, equip, maintain and work a system of tramways, in the township of Bray in the counties of Wicklow and Dublin, and such other light railways or tramways in Ireland or elsewhere as the company may be authorised or enabled to construct, &c. The subscribers (with one share each) are:—Emile Garcke, 1, Gt. Winchester Street, E.C., electrical contractor; James T. Rossitor, Tynwald Grove Park, Chiswick, electrical engineer; Joseph C. Bull, 1, Gt. Winchester Street, E.C., secretary of the Electric and General Investment Company, Limited; John V. Kitchen, 1, Gt. Winchester Street, E.C., secretary of public company; Arthur E. Porte, Dawson Street, Dublin, engineer; John H. Ryan, 22, Nassau Street, Dublin; Edward Lillan, 84, Rathgar Street, Dublin, railway expert. The number of directors shall not be less than two nor more than seven; the subscribers shall appoint the first; qualification, one share; remuneration to be fixed by the company. Registered by Molloy & Molloy, 18, Eustace Street, Dublin.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Harrow Electric Light and Power Company, Limited (44,529).—The registered office of this company has recently been removed from 9, New Inn, Strand, London, W.C to West Street Harrow, Middlesex.

Hampstead General Electric Fitting Company, Limited (41,911).—As this concern has never done any business, and has never appointed directors or other officers, its name will be struck off the Register of Joint Stock Companies.

Rand Central Electric Works, Limited (43,712).—This company's annual return was filed on November 2nd. The capital is £300,000 in £1 shares, and 25,000 are considered as paid. £1 per share has been called on the others, and £274,765 has been paid, leaving £235 unpaid.

Bickle & Co., Limited (36,429).—This company's annual return was filed on October 8th, when 2,027 shares were taken up out of a capital of £50,000, in £10 shares. 1,000 are considered as paid, and £10 per share has been called on the rest. £10,223 has been paid, £50 is in arrears, and £3 has been paid on three forfeited shares.

Electrolytic Plating Apparatus Company, Limited (50,146).—The registered office of this company is situate at St. Paul's Chambers, The Bridge, Walsall.

High Wycombe Electricity Supply Company, Limited. The registered office of this company has been transferred to 43, Lombard Street, London, E C.

Brush Electrical Engineering Company, Limited (29,533).—This company's return was filed on November 19th last, when 90,000 shares of each class were taken up out of a capital of £750,000, in 150,000 ordinary shares of £3 each, and 150,000 preference shares of £2 each. The full amount has been called on each, and £450,000 has been paid.

Monte Video Telephone Company, Limited.—This company's annual return was filed on November 11th. The capital is £220,000, divided into 29,000 preference and 15,000 ordinary shares of £5 each; 28,000 of the former and 15,000 of the ordinary have been taken up, and 3,000 of each denomination are considered as paid. The full amount has been called on the others, and £185,000 has been paid.

CITY NOTES.

Universal Electricity Company (Allgemeine Electricitäts Gesellschaft).

By the courtesy of the Electrical Company, Limited, we have received a copy of the report and balance-sheet of the Allgemeine Electricitäts Gesellschaft, as submitted at the meeting, for its fourteenth business year from July 1st, 1895, to June 30th, 1896.

The company in question has, in addition to its board of directors, a council of inspection, presided over by the distinguished physicist, Dr. G. Siemens. The present report shows success in every department. The capital of the company has been increased by 2,000,000 marks = shillings, and they are able to propose a dividend of 13 per cent. The additional capital has served to acquire a plot of land for the erection of the new machinery department. The total property of the company is valued at 6,710,673·62 marks. The company employs at its 17 establishments in Germany and abroad 6,711 officials and workmen, as against 5,121 in the previous year. There have been made more than 4,000 dynamos and electromotors with a capacity of 74,000 H.P., as against 2,000 machines of 30,000 H.P. in the former year. A right of water conveyance has been acquired convenient to the works on the Upper Spree.

The production of glow lamps exceeds that of the former year by about 600,000 lamps. The production of apparatus for the Röntgen rays has also been taken up, and occupies a special department.

Thirty-four tramlines on their system were at the end of June partly at work, and partly in course of construction. At the close of the business year negotiations with 14 tramlines were in progress.

In addition to the Bitterfeld electro-chemical works, an establishment is projected for the production of chlorine, soda and carbide.

The net profit on the business for the year appears to be 4,638,047·36 marks.

Anglo-American Telegraph Company, Limited.—The Marquis of Tweeddale and Sir Albert J. Leppoc Cappel having retired from the directorate, Sir Gerald FitzGerald and Mr. Robert H. Benson have been elected to fill the vacancies on the board. Mr. F. A. Bevan has been elected chairman of the board.

Commercial Cable Company, Limited.—A quarterly dividend of 1½ per cent. has been declared, together with a bonus of 1 per cent., payable January 1st next. A special meeting has been called for the 22nd inst., to be held in New York.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending November 29th, 1896, were £1,054; week ending December 1st, 1895, £988; increase, £66; total receipts for half-year, 1896, £20,895; corresponding period, 1895, £19,549; increase, £1,346.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of November, 1896, were £2,781.

The Liverpool Overhead Railway Company. The receipts for the week ending November 29th, 1896, amounted to £1,148; corresponding week last year, £1,020; increase, £128.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending November 27th, 1896, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,705.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, Nov. 25th.	Closing Quotation, Dec. 2nd.	Business done during week ended Dec. 2nd, 1896. Highest.	Lowest.
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	4 %	100 —104	100 —104	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	8½— 9½	8½— 9½	...	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 11s.	£2 2s.	£2 9s.	51 — 54	51 — 54	52½	52¼
2,993,560£	Do. do. 6 % Pref.	Stock	£5 2s.	£4 4s.	£4 18s.	96 — 97	96 — 97	97	96¼
2,993,560£	Do. do. Defd.	Stock	...	...	...	10 — 10½	10 — 10½	10 3/16	10⅛
130,000	Brazilian Submarine Teleg., Ltd.	10	6½% §	7 %	7 %	14¾— 15¼	14¾— 15¼	15⅛	15
75,000£	Do. do. 5 %, Debs., 2nd series, 1905	100	5 %	5 %	5 %	113 —117	113 —117	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	... §	2½%	4 %	3¼— 3⅜	3¼— 3⅜	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	157 —162	157 —162	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	2 % §	1½%	1½%	3/16— 4/16	3/16— 4/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	11½— 12½	11½— 12½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	4 %	3½— 4½	3½— 4½	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 10½	10 — 10½	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000	50	...	4½%	4½%	107—110%	107 —110 %	...	...
60,710	Direct United States Cable, Ltd.	20	2½% §	2 %	2½%	9¼— 9⅝	9¼— 9⅝	9½	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½%	6½%	17 — 17½	17½ — 17⅝	17⅝	17 1/16
70,000	Do. 6 % Cum. Pref.	10	6 % §	6 %	6	17½— 18½	17½— 18½	17⅝	...
102,100£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	5 %	104 —107	104 —107	104	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	126 —129	127 —130	129	126½
250,000	Eastern Extension, Australasia and China Teleg., Ltd.	10	7 %	7 %	7 %	17 — 17½	17 — 17½	17⅝	17⅛
54,100£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5 %	5 %	100 —104	100 —104	...	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5 %	101 —104	101 —104	102½	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	128 —131	128 —131	...	...
80,600£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5 %	5 %	101 —105	101 —105	...	...
107,600£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5 %	102 —105	102 —105	104	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4 %	4 %	106 —109	106 —109	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	108 —111 %	108 —111 %	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅜% §	4⅜%	4½%	10⅜— 11¼	10⅜— 11¼	11 1/16	10⅜
180,042	Do. do. 6 % Pref.	10	6 % §	6 %	6 %	17 — 17½	17 — 17½	17 5/16	17
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜%	8⅜%	10 %	24 — 25	24 — 25	24½	...
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	104 —107	104 —107	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	53 — 56	53 — 55	54	...
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6 %	109 —112	109 —112	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000...	5	4 %	4 %	4 %	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 % §	5 %	5½%	7 — 7¼	7 — 7⅛	7¼	7⅛
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	17 — 19	17 — 19	17⅞	17⅝
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	17 — 19	17 — 19	...	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6⅝— 6⅞	6⅝— 6⅞	6⅞	6¾
1,100,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	105 —108	105 —108	105	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	4¼%	5 %	11/16— 13/16	11/16— 13/16	...	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	4 %	108 — 111	108 —111	...	...
11,839	Reuter's Ltd.	8	0 %	*nil*	5 %	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	138 —143	138 —143	139¾	...
58,000	United River Plate Teleph., Ltd.	5	...	3 %	4 %	3½— 3¾	3 — 3½	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	101 —106	102 —107	...	...
15,509	West African Teleg., Ltd., 7,501 to 23,109	10	*nil*	*nil*	4 %	5 — 6	5 — 6	...	...
228,300£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	103 —106	103 —106	104½	...
38,096	West Coast of America Teleg., Ltd.	10	*nil*	*nil*	*nil*	½— 1½	½— 1½	...	...
158,000£	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	8 %	96 —101	95 —101	...	...
64,248	Western and Brazilian Teleg., Ltd.	15	2½% §	3 %	3 %	7½— 8	7½— 8 xd	8	7¾
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	5 %	6½— 6¾	6½— 6¾xd	6½	6⅜
33,129	Do. do. do. Def. Ord.	7½	...	1 %	1 %	1½— 2	1½— 2	...	...
165,200£	Do. do. do. 6 % Debs. "A," 1880 Red.	100	6 %	6 %	6 %	103 —107	103 —107	...	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	6 %	103 —107	103 —107	...	...
88,321	West India and Panama Teleg., Ltd.	10	1⅞%	1⅞%	1⅞%	1⅜— 1⅝	1¼— 1½xd	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11⅜— 12¼	11½— 12 xd	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	9½— 10½	9½— 10½xd	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800	100	5 %	5 %	5 %	108 —111	108 —111	...	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds	$1000	7 %	7 %	7 %	107 —112	107 —112	...	...
164,300£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	6 %	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	4½%	5 %	9½— 10	9½— 10	...	...
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277	5	5 %	5 %	5 %	7⅞— 8¼	8 — 8½	...	...
60,000	Do. do. do. 4½ % Deb. Stock Red.	Stock	...	...	4½%	114 —117	114 —117	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	5 %	5 %	15½— 16½	15½— 16½	16¼	15⅝
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	16½— 17½	16 — 17	17	16⅝
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	130 —135	128 —133	131½	...
22,475	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—22,475	10	...	...	*nil*	8 — 9	8 — 9	8⅛	...
20,000	Do. do. do. 6% Pref., 40,001—50,000	10	...	...	6 %	13⅜— 14½	13⅜— 14½	...	...
10,000	Do. do. do. iss. at 2 pm., all paid	10	...	...	...	7½— 8½	7½— 8½	8½	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000	10	2½%	3 %	4 %	13 — 14	13 — 14	13½	13⅜
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem., £1 paid	10	...	...	...	6½— 7	6½— 7	...	...
150,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	4½%	121 —124	121 —124	123¼	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	1 %	2 %	9½— 10½	9½— 10½	...	...
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	4½%	6½%	7½%	12 — 13	12 — 13	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 — 11	10 — 11	...	...
50,000	Do. do. 4 % Deb. stock Red.	Stock	...	...	...	106 —109	106 —109	...	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000	5	4 %	5 %	7 %	10½— 11½	10½— 11½	11½	10⅞

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless therwise stated all shares are fully paid. ‖ Dividends paid in deferred share warran profits being used as capital.

§ Dividends marked § are for a yea consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation Nov. 25th.	Closing Quotation, Dec. 2nd.	Business done during week ended Dec. 2nd, 1896. Highest.	Lowest
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	3	5 % §	2½%	...	⅞— 1⅛	⅞— 1⅛	⅞	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 % §	3 %	...	1 — 1¼	1 — 1¼	1⅛	1
125,000	Do. do. 4½ % Perp. Deb. Stock... ...	Stock	4½%	4½%	...	110 —113	110 —113	...	...
76,770	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	96 —100	96 — 100	...	...
9,104	Central London Railway, Ord. Shares	10	...	...	...	9¾— 10¼	9¾— 10¼	10	9⅞
207,649	Do. do. do. £4 paid	10	...	...	...	4 — 4¼	3⅞— 4⅛	...	...
630,000	City and South London Railway	Stock	1⅛%	1⅛%	1 3/16%	52 — 54	53 — 55	54½	53½
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	3 % §	*nil*	*nil*	1⅞ — 2¼	1⅞ — 2¼	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	7 %	5 %	5 %	1⅞— 2¼	1⅞— 2¼	...	...
17,139	Do. do. do. "A" Shares 01—017,139	5	7 %	5 %	5 %	3 — 4	3 — 4	...	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	...	4½%	4½%	103 —106	103 —106	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	*nil*	*nil*	5 %	1½— 1⅞	1⅝— 1⅝	...	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	7 %	7 %	7 %	2½— 3	2½— 3	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil*	*nil*	...	⅜— ⅝	⅜— ⅝	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	*nil*	*nil*	...	¼— ½	¼— ½	...	...
9,600	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	*nil*	*nil*	10½%	10½— 11½	10½— 11½	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	6 %	8 %	17 — 18	17½— 18½	...	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	18½ — 19½	18½— 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	...	4½%	109 —114	109 —114	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	10 %	10 %	20½— 21½	20½— 21½	21¼	21⅛
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	105 —108	105 —108	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	1 %	1½%	2⅞%	13⅜— 13½	13¾— 14	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	16⅞— 17⅜	16⅞— 17⅜	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	20 %	15 %	39 — 42	39 — 42	41	40¼
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	104 —107	104 —107	...	...
54,000	Waterloo and City Railway, Nos. 1 to 54,000, £6 paid ...	10	...	...	...	7⅞— 8½	7¾— 8½	...	...

Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
CROMPTON & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%§; 1891—7%§ 1890—8%.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

***Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 7⅞, £5 (fully paid) 9¾.**
Electric Construction Corporation, 6 % Debentures, 103—106.
House-to-House Company (£5 paid), 4¼—4⅝.
Do. do. 7 % Preference, of £5, 8½—9.
Do. do. 4½% Debentures of £100 109—111.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 10—10½; 1st Preference Cumulative 6 %, £5 (fully paid), 8¼—8⅝.
London Electric Supply Corporation, £5 Ordinary, 1—1¼.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 7½—8.

* From Birmingham Share List.

Bank rate of discount, 4 per cent. (October 22nd, 1896).

REVIEWS.

Auto-Cars. By D. FARMAN, M.I.E.E. London: Whittaker and Co., 1896.

This is a translation from the French of Lucien Serraillier, and so far as we can see the work has been well done, and the volume has been made more complete by appendices containing, amongst other things, a copy of the Locomotives on Highways Bill. We observe from the introduction that the auto-car industry is still in its infancy. This is satisfactory. The engineering infant of now many years standing has been electricity, and the arrival of the new baby has clearly put the rather mature predecessor on the shelf. Henceforth, pending the flying infant, it is the auto-car that is in its infancy, and electricians will please note.

The author touches on steam, electricity, and compressed air as motive powers for cars. In fact he gives considerable space to steam, but he reserves his chief energies for petroleum motors, which he considers have a brilliant future. We are ourselves not unfavourably impressed by the petroleum (naphtha) car, for it is so comparatively light and simple and if made by English engineers should prove to be much more reliable than the foreign made vehicles to which we have so far been treated. Undoubtedly their fearsome exhaust will tell more against these cars than the danger of explosive liquid. Care can be taken in regard to the liquid, but nothing yet can take away the smell of the exhaust gases. At the same time it may well be questioned whether the offensive exhaust of a gasolene motor, practically harmless as it is, can for a moment be compared with the nuisances arising from the use of draught animals. Animals pound the streets into mud and add to the mud its most offensive constituents. They render wood paving very offensive in summer. A windy day fills the air with the most disgusting dust, and the nuisance that we are accustomed to is infinitely more unhealthy and unpleasant to eyes, lungs and skin, than the evanescent spirituous exhaust of a motor. This is a point that is we fancy quite overlooked by those who lay such stress upon the smell of the exhaust from a gasolene motor, and is a species of straining at a gnat while swallowing a very camel of nauseous filth in the shape of animal refuse. The earlier part of the book under review is largely a treatise on the thermo-dynamics and mechanics of steam and gas motors.

He next deals with electric motors and states that the weight of an electrical motor is likely to exceed that of a petroleum motor of equal power and this does not include the accumulators, which are heavier than the motor. The electric motor car can, however, be easier worked and controlled than any other, and can use more power at starting while it also has no smell.

The author works out that not more than 54 per cent. of the power of a gas engine or steam engine can be got in the axle of an accumulator driven motor car (a statement not far from the truth) and, taking all things into consideration he considers it perfectly futile to even attempt the accumulator as a motor car driver. He therefore dismisses electricity altogether and confines his further remarks to various steam motors and gasolene cars, with a short chapter on compressed air motors. Indeed, he is quite favourable to air for city use, though it is not economical. It is easily managed. But it is to petroleum he awards the palm, and of petroleum motors to the Daimler, which he looks upon as the king of petroleum motors. He therefore not only describes it fully but gives some history of Daimler himself. We cannot altogether agree with his eulogium on this motor. It is too complicated for ordinary use, and it is a vertical cylinder motor, and this unfits it for auto-car work. It is an Otto cycle motor, and has a timing valve for explosion, compression being taken to from 42 to 56 lbs. The rate of consumption is given at less than 0·11 gallon of petroleum per H.P. hour, the specific gravity of the oil being ·700. This is equal to about ¾ lb. Messrs. Panhard & Levassor use Daimler's motor, and M. Levassor himself drove his car 744 miles, from Paris to

Bordeaux in 48 hours 47 minutes at an average of 15½ miles per hour.

The Peugeot cars also use Daimler motors, and did well in the Paris-Bordeaux race. In the Roger car the Benz motor is used. This is horizontal and was till lately a single cylinder engine, and is apt to cause vibration. We believe the newer cars will have double cylinders with cranks at 180°, thereby reducing vibration. Belts are used to communicate motion to the chain pinion, and there are two speeds, while in some cars we have seen there is a third belt for backing. The Benz motor works on the Otto cycle with electric ignition. In all gasolene engines there is a tendency for the gasolene to be refrigerated by the evaporation, and to prevent this it is necessary to add heat to the carburator either by means of the exhaust, or by using the carburator as an aid to cool the jacket water.

In the American Duryea car the motor is of American invention. Like the Roger and Arnold, the Delahaye and other French cars, belts are employed, but the motor is peculiar. Explosion occurs in a non-working vessel, and gas is passed from this like steam from a boiler to work the motor. The motor can thus be small and light, and can be a three-crank double acting engine. Obviously the amount of oil used will be proportional to the work done. The great drawback is the very high temperature of the pressure reservoir. The description of this car motor is poor and is simply taken from the English patent specification.

In the Kane-Pennington motor the cylinder is not water-jacketed, but is partially cooled off by being used as a vaporiser of the gasolene. There is no separate carburator, and the whole thing is very light and simple and quite good enough not to have needed a ridiculous bolstering up of its vaunted double spark ignition device, which we think has never been satisfactorily proved to be of any value.

Various other cars are described, including that of Delahaye. We have seen one of these cars and found it to be fully equal to any we have yet noticed, its frame of steel tubes and the finish of the parts being good as compared with other cars which we have observed to be rather clumsily put together. The author rightly attributes the vibration of motor cars to the shock of the explosion more than to the want of mechanical balance. In the Delahaye car, there are, however, two cylinders, and mechanical balance is assured as far as it possibly can be with two cylinders.

Referring to the Jeantaud electrical car in the Paris-Bordeaux race this covered half the course, or 370 miles, with relays of batteries every 15 miles. Yet the car arrived far behind all the petroleum cars, and so far it has to be shown that accumulator cars can be worked at any reasonable expense. Each battery of 1,870 lbs., with 570 lbs. of motor and 220 lbs. of fittings, or a total of 2,660 lbs., carried 924 lbs. of passengers only 25 miles, or, at most, 30. Hence the conclusion that accumulator cars cannot economically compete, and the author doubts the fair dealing of the Chicago jury when they awarded first prize to an electrical car because of its virtues in non-smelling and easy driving. The electrobat had four groups of 12 accumulators, with 50 ampere hours capacity per accumulator; each weighs 13 lbs. The total maximum discharge rate is 1 kilowatt hour, and the battery weighs 160 lbs.; and there are four of these groups.

The author doubts the output of 50 ampere hours from 13 lbs. weight. We do not think, however, that he takes a biassed view in favour of gasolene. We fancy few electricians would care to differ from him in respect of all he says as to accumulators as we know them. Electricity can only be stored by electrolysing something, and only in very great improvement of the storage cell can there be any future.

We may agree with Sir David Salomons that steam is the surest and safest power, but we are still unpersuaded that for the general demands of the average man there is anything, for country work at least, that can touch the gasolene motor even in its present crude forms. There is a certain peculiar fitness about the petroleum motor, which, despite its odour, commends itself to one's sense of mechanical fitness. True, as Sir David has remarked, they must be content to do very slow hill climbing. We think they ought to have a wider range of speed on the level, and they ought certainly to be better made; but when better made we really cannot see any reason why a man need hesitate to take one out on a trade journey of a fortnight.

We have only briefly reviewed this excellent book, which is simply full of every kind of information on motor cars. The striking thing in the new industry is the absence of any really valid patent. This book confirms the claim as to lack of patent rights that was lately made by Sir David Salomons. The motor car is essentially a compilation.

Carriages without Horses shall Go! By A. R. Sennett. London: Whittaker & Co. 1896.

Go! Yes, but where are they to go. We find many people who would send them to a place whose name can almost equally well be spelt by dropping three-fourths of its letters in succession. The author of this book is very much mixed up with the Self-Propelled Traffic Association, and he has reprinted his paper of September last, read before Section G. of the British Association at Liverpool, and added an appendix. The book is only partially serious. It is largely historical and descriptive, much in the popular vein, and is illustrated with copies of the pictures exhibited at the meeting as lantern slides, many of which are of some age, and caricatures by the memorable Cruikshank. The historical portion is interesting chiefly, perhaps, as showing that before the harassing legislation of landowners, we English, with our unequalled roads, were well advanced in mechanical road locomotion. Murdoch, Trevithick, Gurney, and Hancock, stand out pre-eminent. Then James and Anderson, Burstall and Hill, designed and ran steam coaches. Gurney began working on the subject in 1822, and surmounted Highgate Hill itself. His coaches ran for months between Gloucester and Cheltenham. Scott Russell was very successful and used a pair of 12 inches × 12 inches cylinders. Hancock ran a line of 'buses from the Bank to Paddington, mounting Pentonville Hill. It is impossible to avoid the conviction that but for opposition too powerful, the steam road carriage would have become a regular part of English life. Railways did not occupy the roads, and they contrived to fight opposition, but they absorbed the energies of our engineers, and the road carriage was forgotten, though it was comparatively a greater success than it is to-day, considering our increased mechanical advantages. The author presents all the arguments in favour of mechanical propulsion. The depreciation of machinery will be less than that of the horse, the total length of vehicle will be reduced by the length of the horse, the wear of roads will be less, for the wear to-day is chiefly caused by hoof pounding, Taking all facts into consideration, it is to be hoped that this country will again lead in regard to horseless road traffic. We ought certainly to do so. If the S.E.R. be not a source of joy to every motor man, it ought to be. Think of the miles of country in Kent and Sussex and Surrey practically unserved by railways. The lines are there it is true, but never a decent train to run on them. No one would ride in a dirty railway carriage, creeping with its joggety jog over myriads of badly jointed rails, when he could travel on the exhilarating motor car through wooded lanes, and draw up in the quaint old world villages, now, perhaps, two or three miles from the station. We have made fun at the motor car, and we fully believe the first fruits of the industry on which the company promoter has already fastened, will be eminently disappointing; but we believe the motor car has really come to stay, and when it gets into safe hands, will really develop. Like Sir David Salomons, Mr. Sennett believes in steam. Many of our friends believe in horses, and we are almost constrained to keep still when they gaze upon the motor car. Their language is plain, unmistakably so. But it won't stop the motor car in some shape or other. Our English roads run through all the villages and little towns in the Kingdom. We never saw a village that had not a road to it. England is particularly suitable for motor cars, for the reason that our roadways run through the country and not about it. In America the railways are lined with the habitable places, because there the places grew up by the railway, whereas in England the railways were laid out on the great and through principle, and half the country is cut off from mechanical travel. Hence the future for motor cars.

Where did Mr. Sennett get the idea that English railways only carry 93 million passengers per year? Per month would

be nearer the truth. On the whole Mr. Sennett has given a very useful and readable account of the motor car question from the beginning, and adds to the value of the book by printing the new Act of 1896, and the Local Government Board regulations.

APPLIED ELECTRO-CHEMISTRY.

By JAMES SWINBURNE.

Cantor Lecture IV.—Delivered before the Society of Arts, May 18th, 1896.

(*Concluded from page* 716.)

By the way, there is no space here for a discussion of electro-chemical analysis, but there is just room for an urgent appeal to analysts not to measure electrical quantity in terms of bang-gas. Until quite lately, electroplaters and writers on electrolysis used the Smee cell as the unit of everything. When they told you they had passed the current of 57 Smee cells through anything, they thought they had given you information. The Smee cell, as a fundamental unit of everything, still lives in the somewhat muddled minds of many writers on electrolysis and electroplating of the old school. But in electro-chemical analysis—which is a new branch of science—surely we might expect chemists to work with volt and ampere-meters, and to use the methods of other scientific men.

Calcium Carbide.

This compound has created an enormous sensation in the financial world, or at least in the speculative part of it, during the last year or so. As far as its discovery in America goes, it appears to have been a mere matter of chance, an invention in the literal meaning of the word. The formation of calcium carbide from carbon and lime seems to be a mere question of temperature, and to have nothing to do with electrolysis. It may be that lime and carbon do not react until the lime is fused or the carbon volatilised, and that the temperature of the electric furnace is needed to bring this result about. It is probable, however, that the very high temperature is necessary to bring about the reaction, apart altogether from getting the lime and carbon into contact. I have tried some experiments with an oxygen furnace, and have not succeeded in making calcium carbide even when I used a solvent for the lime, so that there was no doubt that it came into contact with the carbon. These experiments were not tried thoroughly enough to be conclusive, but they tend to show that an exceedingly high temperature is needed. It is hardly necessary to say that an oxygen furnace, that is to say an injector furnace fed with an oxygen and coal-gas blow-pipe, gives a pretty high temperature.

The future of calcium carbide depends very largely on its cost of manufacture. It is, of course, very absurd to take the cost of coal, lime, and energy, and calling that the cost of the carbide, to compare the cost of a candle-power-hour with that of gas as charged to the consumer. The prime cost of gas delivered into the "hydraulic main" would be the right thing to compare in such a case, and would tell a very different story. On the other hand, the distribution of acetylene may well be much more simple in proportion than that of coal gas. If it is to be delivered by pipes its only advantage, as far as distribution is concerned, is that the pipes will be smaller. This would make but little difference in the total cost of distribution, as it only reduces the capital sunk in mains a little. The cost of laying them would not be very much reduced.

The first thing is to get some idea of the cost of calcium carbide. The estimates given vary enormously, as very little has been published as to actual cost of manufacture. It seems probable, however, that the cost of manufacture—that is to say, the cost of lime, coke, carbons, labour, and energy, taking energy at a farthing per kilowatt hour, will be a little over £6 per ton. If water is used, the price comes out a little lower; but, as already explained, water-power must not be reckoned upon too much, as rents will probably go up soon. It is best to be on the safe side, so we may perhaps take £10 a ton as the final price of electrically-made calcium carbide, capable of giving 5 cubic feet of acetylene per pound, packed and delivered on rail, after paying manufacturers' profits and all charges. This seems a low price, and it may be said that the various aluminium works have all the plant ready, and know exactly the cost of manufacture, and have reduced the price as far as it will go already. The business has really hardly commenced, however, and there is little doubt that the processes will be cheapened. At present, it is the roughest and crudest method imaginable.

Let us assume the final price to be £10 a ton, and see exactly what its future may be at that figure. Allowing 5 cubic feet of acetylene per pound, this gives, in round numbers, 18s. per 1,000 cubic feet. Calcium carbide is not acetylene, however. Suppose the treatment with water raises the acetylene to 20s., and that it gives 20 times as much light as coal-gas, it would then correspond with gas at 1s. per 1,000 cubic feet. Now, let us look at the price of gas. A ton of coal at, say 10s., gives 10,000 cubic feet of gas; so gas should be 1s. per 1,000 cubic feet. But the ton of coal gives 15 cwt. or so of gas coke, which is worth something, and over 100 lbs. of tar, which is valuable, and 20 gallons or so of ammonia liquor. Some of the 15 cwt. of coke is used to heat the retort benches, and labour, &c., has to be paid for, but still the actual value of gas at the hydraulic main is really only a few pence per 1,000 cubic feet, and acetylene has no chance in comparison. The common practice of taking the price—generally the prime cost—of carbide of calcium, reckoning from it the price of acetylene, and comparing it with the price of delivered coal-gas is absurd. In addition, the great difference in lighting power comes in when the acetylene burner, though using little gas, is giving a very powerful light. Except in sitting-rooms, people want small lights about their houses, and they want to be able to turn them down at will.

Acetylene may be used for enriching coal-gas. Whether it will pay depends very much on the local conditions. Cannel coal is usually employed when enrichment is necessary. The prime cost of gas at any works depends on the price of coal and labour, and on the selling price of coke, tar, and ammonia. The cost of scrubbing and purifying would have to be incurred in making acetylene on the large scale, and the cost of distribution by pipes and collection would be about the same in both cases. It is impossible, however, to give any answer as to whether it would pay to enrich coal-gas, unless one knows the real cost price of gas in a given case. Thus to take a rough example, suppose crude gas costs 6d. a thousand cubic feet; so that acetylene costs 40 times as much. Adding 3 per cent. of acetylene would about double its lighting power, so that to replace 1,000 cubic feet of gas, we would have 500 cubic feet costing 3d., and 15 of acetylene costing over 3½d. It is therefore clear that it will not pay to enrich with 3 per cent. of acetylene at these prices. I have not worked out figures to find the best enrichment for each relation of values of acetylene and coal-gas, for it seems clear that unless the cost of carbide is much less, or the cost of crude gas much greater than here assumed, there is no chance of its being utilised in that way. A public company does not make improvements if it can help it, and of all public companies gas companies, owing to their constitution and the sliding scale arrangement, are least likely to adopt such methods as enriching gas, even with the bye-products of electric lighting companies, who make carbide to get decent load factors.

In addition to this, gas is not used only for lighting. It is very largely used now for heating purposes, and the incandescent mantle has come to stay, and people with stoves and Welsbach burners would strongly object to having their gas bills doubled, and their gas contaminated with a body which necessitates their renewing all their gas fittings and removing all copper and brass taps and couplings.

It does not look, therefore, as if acetylene will compete with gas at present. It may be a different matter in other countries. In the United States, for instance, gas is generally very dear. I had charge of a works in Boston some years ago, and we paid 10s. per 1,000 for gas. One shudders to think what it must cost in outlying districts. The enormous strides made by the electric light in America is not owing to the good electrical engineers, but to the bad gas producers. Perhaps the gas works are run by the urban authorities; this would account for anything. If sulphate of ammonia does not fetch good prices in America, and if tar distilling and the manufacture of dyes is not brought to the perfection they are in Europe, it is quite probable that acetylene has a much greater future there than over here, especially as in proportion to the inhabitants water power is much more plentiful, so that power prices may remain low for a very long time.

The next scheme is to deliver calcium carbide to houses, and let the consumers make their own acetylene. All that is needed is to add water. This sounds very simple. In the beginning of the century gas was to be made on the spot in the same sort of way. All you did was to put coal in a retort, and heat it, and off came the gas. Yet this was never practised, except in special cases, and gas never came into use generally until it was distributed by pipes ready for use. There are of course, a few country houses and isolated establishments where they make a fluid they call illuminating gas. Exactly the same thing happened with the electric light. Each house was to have a gas engine and a dynamo, and generate its own power. Then the next idea was, that the accumulators were to be left at the houses with the milk, and changed next day or week or month; but this never came into practice either. These two schemes correspond very fairly with those of distributing carbide for use in generators, and distributing liquid acetylene in bottles. The generators would always be troublesome in an ordinary house. No doubt the light would be much cheaper and better than that of gas, as commonly used, but that is by no means everything. People forget that the average households are controlled by women. Women may understand people, but they are completely wanting in the faculty of understanding things, and they have the unreasoning conservatism and conventionality belonging to the undeveloped mind, as seen in boys and savages. A woman hates everything new, and would never understand how to work an acetylene generator until it had been in use for generations, and it was considered part of the duty of a good housekeeper to make good acetylene, as it used to be to make good beer. Of course, even then it would be done by rule of thumb. There is more than this. The first thing a woman asks when she sees anything new, be it a mousetrap or a telephone, is, "Will it explode?" Now, no one can say on his honour that an acetylene generator won't explode. He does not think it will, in fact he feels sure it won't, and he sincerely hopes it won't, but an explosion might possibly occur. This settles the matter. The only thing to be done would be to utilise a woman's instinctive hero worship and belief in authority, and to arrange that acetylene generators should be recommended by her clergyman or doctor. I say her doctor advisedly, as she does not believe in other women's doctors.

The plan of distributing liquid acetylene in iron bottles sounds more promising, as very little goes a long way, and the bottles could

be connected to the house service by the acetylene company without the women of the house having anything to do with the matter. Acetylene is given off on the addition of water to the carbide, at enough pressure to liquefy in a cold bottle at once, and it might be purified at the same time. It must be remembered, however, that the comparison must be made, as to cost, not with gas burned in the ordinary batswing burner, which is generally not even good of its kind, but with the incandescent mantle. If anyone is going to improve his lighting, he will not take up acetylene, as against the incandescent burner, unless it is better. Acetylene gives, for a cubic foot, about three times the light of the Auer burner, so that, at 20s. per 1,000 cubic feet, it corresponds to gas at 6s. 9d. Gas seldom costs 6s. 9d. per 1,000. Besides, it is easier to put in the Welsbach burners; but if a considerable alteration is to be made, the electric light may be preferred.

All the same, there is a very large opening for acetylene, apart from competition with coal-gas. For country houses, and in carriages, omnibuses, trains, and on board ship, it ought to have its own way. One of the chief things wanted is a good burner, that will not give smuts under any conditions.

A good portable acetylene lamp is also much needed. If the lamp generates its own acetylene there is the difficulty of having it attended to properly, at least by maidservants. Even paraffin lamps are seldom in good order where there are no men servants, and the old colza oil lamps never were. There are other difficulties, however. The action of the carbide on the water is so energetic, that each time they touch too much acetylene is given off, and some sort of gasholder is needed. I have tried mixing alcohol with the water to reduce the vigour of the action, and it works fairly well. I have lately found that this plan has been already fully worked out. Another difficulty is that the water gives off vapour which generates acetylene, so that when the lamp is out of use acetylene is being generated slowly. This means that the lamp will smell, and the smell of acetylene is not pleasant.

Small bottles of liquid acetylene for portable lamps should be no more difficult to deal with than mineral water syphons, and a small steel tube bottle would run a light and portable 10 candle-power lamp for a long time. The want of portability is the great drawback to gas. The electric light is a little better, but not much. The result is that candles are still used. Acetylene lamps would not ruin the carpets, or cement the piano keys together.

Too much has been generally said about the poisonous nature of acetylene. Experiments show that it is not at all a serious poison, and its smell is a great safeguard. It uses so little air in burning that, on the whole, it would be a very much more healthy illuminant than gas, oil, or candles, especially if it contains no sulphur. Healthy breathing is not generally sufficiently appreciated yet. Many people still sit in close rooms and sleep with their windows shut, and the smaller air consumption of acetylene would not really appeal to them very much. Besides, according to experiments recently made on polluted air, the evils of vitiated atmosphere have been greatly exaggerated. Though acetylene, like carbon disulphide, is an endothermic compound, it is not easily exploded. Fulminate of silver only fires it locally. The explosion does not spread. Carbon disulphide explodes under curious conditions. If some is put in a bulb, and an air pump connected and used, it will go off. I do not know if acetylene has any analogous properties.

Calcium carbide may come to be used in the manufacture of alcohol, benzene, and other organic products, but it is too soon to prophesy its future in these directions. A great deal must depend on its price, and one of the chief items is the cost of electrical power. It is to be hoped that it will soon be made by non-electrical methods, and its price may then be reduced considerably.

PROCEEDINGS OF SOCIETIES.

The Institution of Electrical Engineers.

At the meeting on the 26th, the discussion on Mr. Gavey's paper, on The Telephone Trunk Line System in Great Britain, very little was brought out which had not been already dealt with in Mr. Gavey's exhaustive paper.

The President asked Mr. Gavey whether he had found any disturbances in the telephone circuits, due to electric tramway currents, and what means he would propose to guard against such disturbances?

Mr. Gavey explained that the principles laid down in his paper were of general application, and indicated how telephone lines could be best protected against all external disturbances. These principles, however, applied to looped circuits only. He knew of no plan by which single wire lines could be protected against disturbances from earth currents.

Mr. Kingsbury spoke very highly of Mr. Gavey's paper, and the trunk line system which he had described. Mr. Gavey had said that the cross system was sometimes used instead of the twist system, and he (the speaker) would like to know whether in a large number of circuits the cross system is more readily amenable to treatment? He hoped that Mr. Gavey would in future adopt the more general nomenclature, and not continue the use of the term "peg" for what had hitherto been called "plug." He said that Preece's automatic system of signalling was undoubtedly an admirable one from the subscriber's point of view.

Mr. O'Gorman asked why the Post Office used so much thicker wire than the telephone companies, and what was considered to be the best relation between resistance and capacity?

Mr. Phillips considered that the paper left very little room for discussion. They would remember that in the switchboards shown at the last meeting there was ample space, but in many of the telephone exchanges space was very valuable, and had to be economised, so that instead of the visual indicators of the Post Office, they used in their exchanges small lamps lighted by a relay actuated by the withdrawal of a plug at the junction end of the wire.

Mr. A. A. C. Swinton said that whenever he wished to use the trunk telephone lines, he found that he had first to send a telegram to his friend to bring him to the other end of the wire. This had, on some occasions, cost him as much as 15s. He thought the telephone department of the Post Office should perform this work, and ring up the speaker when his friend had arrived at the telephone.

A long discursive communication from Major-General Webber was read by Mr. Sinclair. He considered that the telephone system was as yet far behind the telegraph system, which had attained the maximum of efficiency. Telephony was chiefly an engineering question, and therefore ought to be under the control of the engineering, and not the commercial department. The Post Office had given no indication of the future extension of the telephone. He then referred to the system which he had explained at the British Association at Ipswich and in a letter to the Electrical Review, according to which the local authorities were to control local telephone systems. He proposed to divide subscribers into two classes, local subscribers and trunk subscribers.

Mr. Sinclair said that, contrary to what had been supposed, he had no objection to the visual signal system; he was, in fact, introducing this system at the present time. These signals have several advantages over the bells; but he imagined the Post Office would yet adopt a combination of the two. He thought that policy, rates, and analogous questions were not suitable subjects for discussion before the Institution of Electrical Engineers.

Prof. Ayrton congratulated Mr. Gavey on his paper, and was especially pleased to hear a paper read before the Institution in which there was no mention of hysteresis or trolley wires, and thought that there ought to be more papers read on telegraphy, and especially on telephony. He was rather surprised at the results which Mr. Gavey had obtained for the capacities of the wire to earth, and from wire to wire, and wanted to know how the measurements had been made. He (Prof. Ayrton) and Oliver Heaviside had calculated the ratio of these capacities, and found that the capacity from wire to wire should be greater than from wire to earth. Mr. Gavey has obtained the reverse of this result. He, Prof. Ayrton, had also calculated that the disturbances due to electrostatic induction increase faster with the length of the wire than those due to electro-magnetic induction; but this, too, appeared to contradict Mr. Gavey's experience. Currents produced by electro-magnetic induction would be independent of the length of the wire, if the resistance of the instruments be neglected; electrostatic induction currents, on the contrary, ought to increase with the length of the wire since the surface of the condenser is increased. He should also like to know whether the speed of signalling by telephones was increased by the presence of earth faults, as it was known to be in ordinary telegraphic signalling.

Mr. Preece said that Mr. Gavey's paper was read in fulfilment of a promise which he had made to the Institution some time ago. The transfer of the telephone trunk lines to the Post Office was an affair of greater magnitude than the transfer of the telegraphs in 1870. It had gone off well, because the officers of the Post Office and of the telephone companies had worked harmoniously together. The only people who were not satisfied were the anonymous scribblers to the newspapers. However, they got quite as many pats as kicks from the public, and they were comforted. Mr. Preece had studied the working of telephone trunk lines in America and on the Continent, and read all available documents on the subject before commencing the work in this country. He thought, therefore, that the system was as nearly perfect as possible. As to the influence of leaks on the speed of signalling, it had been proved that they did increase the speed of signalling on telegraphs, except where electrolysis occurred, as in faults in cables. He had not yet been able to make any experiments on telephone lines, but hoped soon to be able to make tests.

Mr. Gavey, in reply to Mr. Kingsbury, said that undoubtedly the twist system was theoretically the best. In the cross system, when there was a very large number of wires, the crosses became too numerous. As to the nomenclature, it did not appear to him to be of much importance whether they called a thing a "peg" or a "plug," provided they did not put a square peg in a round hole. To Mr. O'Gorman he pointed out that it was not intended to use the thick wires in every case, but wires had often to be made thicker than necessary at first, with a view to future extensions. In reply to Mr. Phillips, he said there was no ground for reducing the size of the switchboard, since space had to be provided for one operator to work five lines. He objected to the lamp signals, because a lamp was liable to break down without the fact being noticed; he preferred the grid indicator as used by the department. To carry out Mr. Swinton's idea of making appointments by telephone would necessitate the laying down of a number of idle lines; since during the busiest part of the day there was a constant flow of business, and each one had to be taken in turn. The Government were still buying up lines; the whole undertaking was at present in a state of transition. When it was completed the waiting would be reduced to a minimum. He did not agree with Major-General Webber's remarks on engineering *versus* commercial control of the telephone business; it was opposed to the experience of railways and other great and successful undertakings. In reply to Prof. Ayrton, he stated that the capacity of wire to earth was measured when all neighbouring circuits were insulated. The electro-magnetic effects were measured with high resistance galvanometers, which was more like the working conditions than the assumption made in Prof. Ayrton's calculation.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1896.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*]

25,729. "Improvements in electric meters." E. Batault. Dated November 16th.

25,788. "Improvements in or relating to the strengthening of electric currents." M. Reichsritter von Leon. Dated November 16th.

25,798. "Improvements in the manufacture or production of chlorates and hypochlorites of potassium and sodium by electrolysis, and in apparatus therefor." J. Greenwood. Dated November 16th.

25,799. "Improvements in the construction of electrodes for accumulators." F. W. Schneider. Dated November 16th.

25,804. "Improvements in the electrolytic production of zinc and alkalies." Dieffenbach. Dated November 16th. (*Complete.*)

25,844. "Means for storing up the electricity generated by the application of the brakes to the wheels of motor cars or locomotives." M. E. Thomas, W. F. Toops, J. M. Hulen, H. L. Hendrick, E. La Rue Hendrick, and R. W. Hendrick. Dated November 17th. (*Complete.*)

25,895. "Improvements in electric arc lamps." A. B. Blackburn and G. W. Fairall. Dated November 17th.

25,896. "Improved electric insulators." C. W. Sax. Dated November 17th.

25,903. "Improvements in controlling electric arcs." The British Thomson-Houston Co., Ltd. (Elihu Thomson, United States.) Dated November 17th. (*Complete.*)

25,904. "Improvements in regulating polyphase circuits." The British Thomson-Houston Co., Ltd. (A. H. Armstrong, United States.) Dated November 17th. (*Complete.*)

25,906. "Improvements in contact systems for electric traction." W. P. Thompson. (T. I. Coppin, South Africa.) Dated November 17th.

25,943. "Improvements in or connected with portable electrical apparatus." J. Mayer. Dated November 17th. (*Complete.*)

25,948. "Improvements in electric accumulators and in the manner of their use." C. P. F. Clerc and A. G. Pingault. (Date applied for under Patents, &c., Act, 1883, Section 103, August 8th, 1896, being date of application in Belgium.) Dated November 17th. (*Complete.*)

25,965. "Improvements in the electro-deposition of metals." J. B. Brooks and J. Holt. Dated November 18th.

25,989. "Improvements in generating plant for producing alternately or simultaneously continuous and alternating currents of electricity." G. Adams. Dated November 18th.

26,000. "Combination of electrolysis and Röntgen rays." D. Greville. Dated November 18th.

26,003. "Improvements in electrically propelled velocipedes, carriages, and other like vehicles." C. Adams-Randall. Dated November 18th.

26,009. "Improvements in and relating to electric light and current regulating switches." W. Welford and L. Hendle. Dated November 18th.

26,053. "Improvements in electric controllers." W. H. Morgan. Dated November 18th. (*Complete.*)

26,069. "New or improved electrical lighting or igniting apparatus." E. Oldenbourg. Dated November 18th. (*Complete.*)

26,099. "Improvements in and connected with means for electrically lighting railway carriages." E. Dick. Dated November 19th.

26,100. "Improvements in and in connection with the manufacture of electrodes for secondary electric batteries." H. Leitner. Dated November 19th. (*Complete.*)

26,144. "An improved electric switch especially intended for controlling and regulating the speed of electric motors." E. F. Moy. Dated November 19th.

26,155. "Improved means for jointing electrical conductors." R. C. Jackson. Dated November 19th.

26,184. "Improvements in electrodes for secondary or storage batteries." G. J. Epstein. Dated November 19th.

26,200. "Improvements in electrically lighting incandescent and other gas burners." F. R. Boardman. Dated November 20th.

26,246. "Improvements in trolley mechanism for electric tramways." Cie de L'Industrie Electrique. (Date applied for under Patents, &c., Act, 1883, Sec. 103, May 16th, 1896, being date of application in Switzerland.) Dated November 20th.

26,247. "An improved manufacture of moulded battery cells, and other moulded articles." A. E. McKechnie. Dated November 20th.

26,249. "Improvements in electrical heating apparatus." H. J. Dowsing. Dated November 20th.

26,267. "Improvements in enamelling processes for electric heating apparatus." R. E. B. Crompton and E. J. Fox. Dated November 20th.

26,275. "An improvement in or relating to boxes for electric conduit wiring." C. N. Russell. Dated November 20th.

26,281. "Improvements in or relating to the manufacture of metal sheets or strips by electro-deposition." K. Klie. Dated November 20th. (*Complete.*)

26,303. "Improvements in dynamo electric machines." W. L. Wise. (Aktiebolaget de Lavals Angturbin, Sweden.) Dated November 20th.

26,307. "Improvements in electric indicators." F. C. Allsop. Dated November 21st.

26,313. "An automatic regulator for alternating or rectified currents." W. Langdon-Davies. Dated November 21st.

26,375. "Improvements in electrical trains and railways." T. Petersen and W. D. Reid. Dated November 21st.

26,425. "Improvements in electric railways and their vehicles." R. C. Sayer. Dated November 21st. (*Complete.*)

ELECTRICAL PATENTS OF 1882 EXPIRING IN DECEMBER, 1896.

We are informed by Messrs. W. P. Thompson & Co. that about 75 applications for electrical patents were filed in the month of December, 1882. Only two of the patents granted on these applications have been maintained for their full term, and being of considerable interest, we give short abstracts of them below:

5,757. "Improvements in the manufacture and preservation of insulated electric conductors and in compounds that may be used for the same and for other purposes." E. T. Trumann. Dated December 2nd, 1882. An insulating material for electric conductors is made by mixing in an ordinary masticator or in apparatus described in Specification No. 878, of A.D. 1870, dry, selected, and sifted blacklead with gutta-percha or India-rubber, the proportion of blacklead varying from two-sevenths to half of the total mixture. A stated small proportion of ozokerit may also be added. The compound with or without ozokerit is well rubbed into the surface of an insulated conductor as a protective and lubricant coating. The parts exposed in joint boxes of the pipes as well as the coils of wire in a dynamo electric machine are similarly covered up or coated. In some cases blacklead or the compound is used to impregnate or cover tapes, threads, or strands used in the manufacture of insulated electric conductors or cables. The blacklead and gutta-percha compound may be vulcanised but in such manner as not to interfere with the flexibility of the conductors. 4 claims.

6,058. "Improvements in the treatment at high temperatures of alkaline salts and metals and apparatus suitable to such treatment." C. A. Faure. Dated December 19th, 1882. The inventor raises the material to a moderate temperature by external heating and attains the high temperature required by applying the heat of electric arcs, currents, or discharges, directly to the alkaline matter. The description and drawing indicate a furnace with a metal casing supporting the structure and containing a very refractory block or lump within which is a cavity having at its bottom a drumlike grating to turn on its axis and discharge the residual carbonaceous matters. The materials for treatment are placed in a covered tube forming an upward continuation of the cavity and surrounded by a flue or jacket through which the heat from an adjacent fire grate passes. A lateral passage leads the vapours produced during the reaction from the cavity to the external conductors. Carbon, iron, or other pencils or electrodes are adjusted in radial openings through the said block to slide longitudinally as the resistance to the electric current demands. Their movement is generally automatic and regulated by the current itself, electro-magnet bobbins being traversed by a small part of the current permit a movement co-ordinated therewith. The materials already heated in the tube on reaching the cavity come under the influence of additional very high temperature. 4 claims.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Copies of any of these Specifications may be obtained of* Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., *price, post free,* 8½*d.* (*in stamps*).]

1895.

12,871. "Improvements in electrical circuit closers." C. A. McEvoy. Dated July 3rd, 1895. Relates to electric circuit closers. The ends of the conductors are clamped between two plates carried on two plungers which are normally forced out by springs. The plungers are of such length that the circuit is not completed until both are fully pressed in. A safety device is provided for placing on the neck of one of the plugs for preventing its movement when desired. 2 claims.

13,175. "Improvements in or relating to telephone exchange switchboards." R. Stock. Dated July 8th, 1895. In a multiple exchange apparatus for central telephone stations in order to increase the number of switches within the reach of one operator, the switchboards are arranged horizontally and the switch bands have sloped edges numbered so as to facilitate reading from either side. One half of the switches are arranged behind the operator, the switch bands being narrow enough to permit an operator on either side to reach over to the other side. The bands are fitted with vertical holes to receive the spring jacks and are carried by a frame having bolts carrying the cable supports which are so suspended that they can be turned aside to reach the cables supported by hooks on the supports. On both sides of the switch board are horizontal plug boards, vertical annunciator frames, and horizontal key boards. The microphones are suspended by conducting cords passing over pulleys and carrying counterweights. 3 claims.